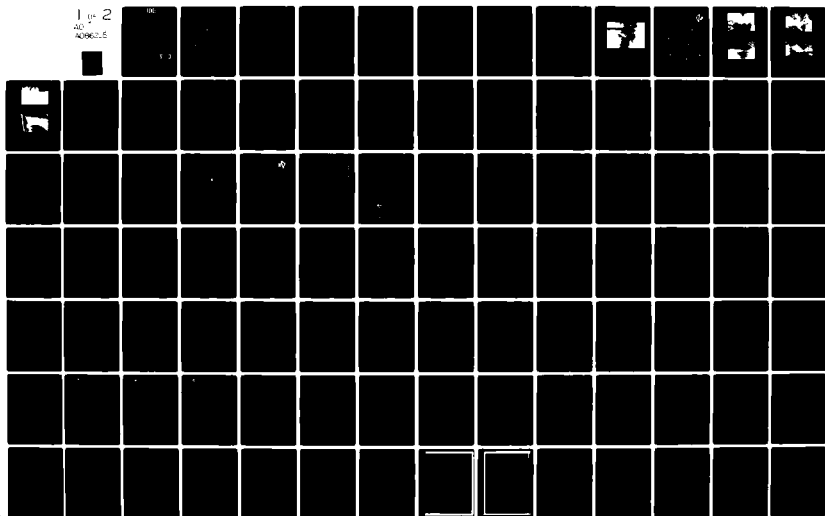


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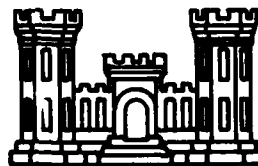
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PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety National Dam Safety Program Visual Inspection Hydrology, Structural Stability St. James Lake Dam Jefferson County LeRay-Fort Drum		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization. St. James Lake Dam, a small, low hazard dam, is an earthen dam constructed in approximately 1923. It is located just north of the Ft. Drum cantonment area. No plans exist for the dam, however, field surveys were taken as part of this inspection. A significant feature of the dam is that it has no emergency spillway outflow occurs. Only through a service spillway consisting of twin 42 inch pipes. The drainage area is 5.14 square miles.		

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The spillway capacity of 400 cfs is only 3 percent of the Probable Maximum Flood (PMF) which was computed to be 13,670 cfs. The 1/2 PMF is 7,046 cfs. Therefore, the dam cannot pass the 1/2 PMF without being overtopped. The downstream hazard is a lightly traveled road that travels northerly from the cantonment area.

1. The discharge capacity of the spillway is inadequate for all flows in excess of 3 percent of the PMF (spillway capacity = 400 cfs). The spillway is not considered seriously inadequate based on the Corps of Engineers' screening criteria since the hydrologic/hydraulic analysis indicates that failure of the dam would not pose a high hazard to loss of life from large flows downstream from the dam. However, consideration should be given to provide an emergency spillway adequate to pass 1/2 of the PMF without damage to the structure. This may be accomplished by the construction of an emergency spillway on the undisturbed bank of the impoundment.
2. The deteriorated apron of the existing service spillway should be repaired immediately.
3. Investigations should be completed within one year to determine the source of seepage noted near the wing wall of the existing spillway.
4. The structural stability of the dam should be evaluated within one year. This evaluation should be based on the data collected in a soils investigation program on the embankment section of the dam.
5. An adequate warning system should be developed immediately to be used in the event of the potential failure or flooding.
6. Within one year, the trees and brush should be removed from both the upstream and downstream face of the embankment section. The upstream face should be protected from erosion by wave action by the placement of riprap at the waterline of the impoundment.
7. Within two years, some means should be provided for draining of the impoundment for inspection and/or maintenance procedures.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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TABLE OF CONTENTS

	<u>Page</u>
Preface	
Assessment of General Conditions	i-ii
Overall View of Dam	iii-vii
Section 1 - Project Information	1-4
Section 2 - Engineering Data	5
Section 3 - Visual Inspection	6-7
Section 4 - Operational Procedures	8
Section 5 - Hydraulic/Hydrologic	9-11
Section 6 - Structural Stability	12-14
Section 7 - Assessment/Remedial Measures	15-16

FIGURES

Figure 1 - Location Map	
Figure 2 - Survey Sketch Showing Downstream Hazard	
Figure 3 - Survey Sketch Showing Plan of Dam	
Figure 4 - Drainage Basin Sketch	

APPENDIX

Field Inspection Report	A
Previous Inspection Reports/Relevant Correspondence	B
Hydrologic and Hydraulic Computations	C
References	D

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam St. James Lake Dam NY779

State Located New York
County Located St. Lawrence
Stream Pleasant Creek
Date of Inspection May 2, 1979

ASSESSMENT OF
GENERAL CONDITIONS

St. James Lake Dam, a small, low hazard dam, is an earthen dam constructed in approximately 1923. It is located just north of the Ft. Drum cantonment area. No plans exist for the dam, however, field surveys were taken as part of this inspection. A significant feature of the dam is that it has no emergency spillway outflow occurs. Only through a service spillway consisting of twin 42 inch pipes. The drainage area is 5.14 square miles.

The spillway capacity of 400 cfs is only 3 percent of the Probable Maximum Flood (PMF) which was computed to be 13,670 cfs. The 1/2 PMF is 7,046 cfs. Therefore, the dam cannot pass the 1/2 PMF without being overtopped. The downstream hazard is a lightly traveled road that travels northerly from the cantonment area.


1. The discharge capacity of the spillway is inadequate for all flows in excess of 3 percent of the PMF (spillway capacity = 400 cfs). The spillway is not considered seriously inadequate based on the Corps of Engineers' screening criteria since the hydrologic/hydraulic analysis indicates that failure of the dam would not pose a high hazard to loss of life from large flows downstream from the dam. However, consideration should be given to provide an emergency spillway adequate to pass 1/2 of the PMF without damage to the structure. This may be accomplished by the construction of an emergency spillway on the undisturbed bank of the impoundment.
2. The deteriorated apron of the existing service spillway should be repaired immediately.
3. Investigations should be completed within one year to determine the source of seepage noted near the wing wall of the existing spillway.
4. The structural stability of the dam should be evaluated within one year. This evaluation should be based on the data collected in a soils investigation program on the embankment section of the dam.

5. An adequate warning system should be developed immediately to be used in the event of the potential failure or flooding.
6. Within one year, the trees and brush should be removed from both the upstream and downstream face of the embankment section. The upstream face should be protected from erosion by wave action by the placement of riprap at the waterline of the impoundment.
7. Within two years, some means should be provided for draining of the impoundment for inspection and/or maintenance procedures.

Dale Engineering Company.

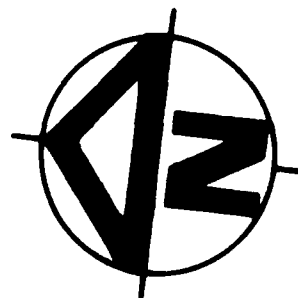
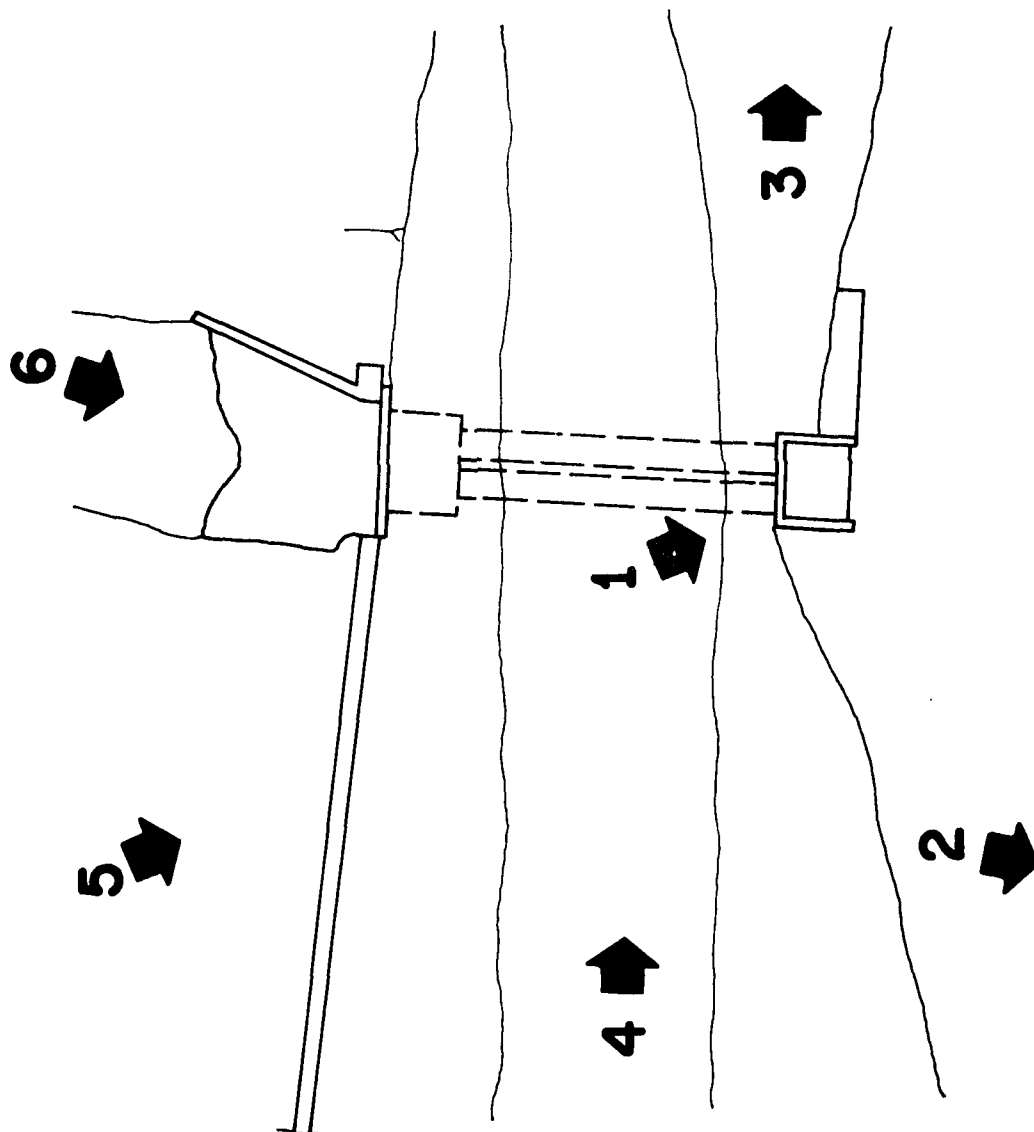

John B. Stetson, President

Approved By:
Date: 14 Feb 80


Col. Clark H. Benn
New York District Engineer



Overview of front of dam showing service spillway.
Dam does not have an emergency spillway or weir type
spillway.



PHOTOGRAPH KEY PLAN



1. Close-up of inlet structure of service spillway.
Spillway can be seen on right wall.



2. View of upstream reservoir.



3. Large tree growth on upstream face of dam.



4. View of earthen road across top of dam. Ratio of width of dam to height of dam quite large.



5. Downstream face of dam contains significant large tree growth.



6. Downstream view of service spillway pipes. Discharge channel lined with concrete with large cavity in concrete at toe of embankment and natural channel.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM - ST. JAMES LAKE ID# - NY799

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

Authority for this report is provided by the National Dam Inspection Act, Public Law 92-367 of 1972. It has been prepared in accordance with a contract for professional services between Dale Engineering Company and Department of the Army, New York District, Corps of Engineers.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the St. James Lake Dam and appurtenant structures, owned by the United States Government, Fort Drum Military Reservation, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the New York District, Corps of Engineers.

This Phase I inspection report does not relieve an Owner or Operator of a dam of the legal duties, obligations or liabilities associated with the ownership or operation of the dam. In addition, due to the limited scope of services for these Phase I investigations, the investigators had to rely upon the data furnished to them. Therefore, this investigation is limited to visual inspection, review of data prepared by others, and simplified hydrologic, hydraulic and structural stability evaluations where appropriate. The investigators do not assume responsibility for defects or deficiencies in the dam or in the data provided.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The St. James Lake Dam is an earth fill embankment approximately 200 feet long with an irregular top width of approximately 20 feet. The height of the structure is approximately 20 feet. The dam is traversed by a dirt road that forms a part of military reservation road network.

The upstream face of the dam slopes gradually at a slope of 1 vertical to 4 horizontal into the impoundment. The downstream slope varies and in some areas the downstream slope is supported by a masonry wall.

Just to the east of the outlet channel at the toe of the downstream slope exists the remains of an old mill building. The flow from the reservoir is conducted across an 8-1/2 foot wide spillway structure which discharges through two 42 inch iron pipes to a concrete and masonry apron on the downstream slope of the dam. The concrete apron at the outlet of the 42 inch pipes was badly deteriorated near the toe of the slope. The receiving stream is overgrown with brush but there is no evidence of recent erosion in the channel.

The impoundment formed by the St. James Lake Dam is used for recreational purposes. There is no facility for draining the impoundment and no emergency spillway provided.

b. Location

St. James Lake Dam is located in the Town of LeRay, Jefferson County, New York. The facility is also located on the Fort Drum Military Reservation.

c. Size Classification

The maximum height of the dam is approximately 20 feet, the storage volume of the dam is approximately 105 acre feet. Therefore the dam is in the Small Size Category as defined by The Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The receiving stream from the impoundment flows through an undeveloped section of Fort Drum. Approximately 1500 feet downstream from the dam the receiving stream crosses one of the main roads serving the military post. This road is not heavily traveled, therefore, the dam is in the Low Hazard Category as defined by The Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by the United States Army.

f. Purpose of the Dam

The dam presently impounds a reservoir which is used for recreational purposes for the Fort Drum Military Reservation.

g. Design and Construction History

Documents collected from the New York State Department of Environmental Conservation indicate an application for construction of the dam was made in January 1923. There is no evidence as to when the dam

was constructed. The description of the dam in the permit application does not conform to the configuration found in the field. There is no information available as to the date of the construction of the present facility or of any of the details of construction.

h. Normal Operational Procedures

There are no formal operating procedures for the facility. The road across the dam is a part of a lightly traveled network of military roads in the area. The impoundment is used for recreational purposes and normal surveillance would be provided through the use of this facility.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of the St. James Lake Dam is 5.137 square miles.

b. Discharge at Dam Site

No discharge records are available for this site.

Computed discharges: (Through twin 42 inch pipes, no emergency spillway)

Ungated spillway, top of dam	400 cfs
PMF	13,760 cfs
1/2 PMF	7,046 cfs
Draw down, (Through Service Spillway Only)	400 cfs

c. Elevation (Assumed Datum)

Note: There is no U.S.G.S. control in the area. Elevations were measured in local datum and approximate U.S.G.S. elevations are given in parenthesis.

Top of dam	102.6	(517.0)
Maximum pool - PMF		(525.16)
1/2 PMF		(522.08)
Spillway crest	95.5	(511+)
Stream bed at centerline of dam		(494+)

d. Reservoir

Length of maximum pool (PMF)	5000 FT (1/2 PMF)
Length of normal pool	2500 FT

e. Storage

Top of dam	288+ Acre Feet
PMF	438 Acre Feet
1/2 PMF	381 Acre Feet
Normal pool	179 Acre Feet

f. Reservoir Area

Spillway pool

18.37+Acre

g. Dam

Type - Earth fill

Length - Approximately 200 feet

Height - 20 feet

Freeboard between normal reservoir and top of dam - 4 feet

Top width - Irregular 20+ feet

Side slopes - Upstream 1 vertical/4 horizontal
Downstream varies

Zoning - Unknown

Impervious Core - Unknown

Grout Curtain - Unknown

h. Spillway

Type - Weir - service spillway, no emergency spillway.

Length - 8.5 feet weir discharges through twin 42 inch iron pipes.

Crest Elevation - Datum - 98.26 (509.26).

Gates - Stop planks in service spillway.

U/S Channel - Natural.

D/S Channel - Natural stream channel.

i. Regulating Outlets

Regulation of water level through use of stop planks in service spillway. Three feet of stop planks in place at time of inspection.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

There is no information available regarding the design of this facility.

2.2 CONSTRUCTION

No information is available regarding the construction of this facility.

2.3 OPERATION

See Section 4.

2.4 EVALUATION

Although there is no engineering data or construction information available for this facility, the fact that the impoundment is in the Small Size classification and Low Hazard classification allows evaluation of this facility for the Phase I investigation.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The St. James Lake Dam was inspected on May 2, 1979. The dam presently functions to provide a recreational facility for the Fort Drum Military Reservation.

b. Dam

The dam and spillway are shown in the Sketches prepared by Dale Engineering Company in Figure 3. The date of the construction of the dam is not known, nor are the materials of construction. The dam is apparently constructed of earth fill. The embankment is poorly maintained and large trees have grown on both the upstream and downstream slopes of the dam. Some trees had been cut on the downstream slope and the cuttings were left on the face of the dam. A masonry wall located just to the west of the downstream outlet is in deteriorated condition as is the apron on the principal spillway. Some seepage was noted just to the east of the principal spillway. Substantial flow was observed under the east wing wall of the outlet structure. No bank protection is provided on the upstream face of the dam.

c. Spillway

The control spillway was operating at a head of approximately 3 inches at the time of the inspection. Stop planks were in place in the outlet structure to an elevation of 2 feet 9 inches above the spillway level.

d. Appurtenant Structures

There are no structures appurtenant to this dam. No provisions are made for draining of the dam except for the removal of stop planks in the control spillway.

e. Reservoir Area

The reservoir area is generally forested and does not contribute significant amounts of sediment into the impoundment. There are no areas where bank instability was noted around the impoundment.

f. Downstream Channel

The area downstream from the dam is on a flat gradient. No recent erosion was noted in the receiving stream.

3.2 EVALUATION

Visual inspection reveals that there is moderate to severe deterioration in the principal spillway apron which forms a portion of the downstream slope of the embankment dam. There is also some seepage located near the wing wall which forms the downstream apron channel. Both the upstream slopes of the earth embankment and the downstream slopes are heavily overgrown with trees and brush. Large diameter willow trees are located along the waterline of the impoundment along the upstream slope. There were no signs of cracking or structural instability in either the top of the bank or the downstream slopes. A masonry wall which supports a portion of the roadway across the dam is in a deteriorated condition, however, this masonry wall does not appear to contribute to the structural competency of the facility. The dam in general is poorly maintained and there is no program of periodic inspection of the facility.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The operation of the stop planks in the control spillway was not observed by the Inspection Team. Inquiry with the facility engineer at the Fort Drum Military Reservation indicates that no program of operation is in effect at the facility.

4.2 MAINTENANCE OF THE DAM

The dam is maintained by the facilities engineer at the Fort Drum Military Reservation.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE BASIN CHARACTERISTICS

The St. James Lake Dam is located on Pleasant Creek approximately 1 mile north of the Ft. Drum cantonment area. The drainage area at the dam is 5.14 square miles. The topography consists of mildly sloped terrain with runoff partially originating in the cantonment area.

5.2 ANALYSIS CRITERIA

The purpose of this investigation is to evaluate the dam and spillway with respect to their flood control potential and adequacy. This has been assessed through the evaluation of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the flood through the reservoir and the dam's spillway system. The PMF event is that hypothetical flow induced by the most critical combination of precipitation, minimum infiltration loss and concentration runoff of a specific location that is considered reasonably possible for a particular drainage area. Since this dam is in the Small Dam Category and is a Low Hazard, the guidelines criteria (Ref. 1) require that the dam be capable of passing one-half the Probable Maximum Flood.

The hydrologic analysis was performed using the unit hydrograph method to develop the flood hydrograph. Due to the limited scope of this Phase I investigation, certain assumptions, based on experience were used in this analysis and in the determination of the dam's spillway capacity to pass the PMF. In the event that the dam could not pass the 1/2 Probable Maximum Flood without overtopping, an additional analysis is to be performed on potential dam failure providing the dam was classified a high hazard. This process is done with the concept, that if the dam is unable to satisfy this criteria, further refined hydrologic investigations would be required.

Since the St. James Lake Dam is a Low Hazard Classification and not a High Hazard Classification, hydrologic dam break analysis has not been provided.

The U.S. Army Corps of Engineers, Hydrologic Engineering Center's Computer Program HEC-1 DB using the Modified Puls Method of flood routing was used to evaluate the dam, spillway capacity, and downstream hazard.

The unit hydrographs were defined by Clark Coefficients, T_c and R . The Probable Maximum Precipitation (PMP) was 18.5 inches, Hydrometeorological Report (HMR #33) for a 24 hour duration, 200 square mile basin. Base flow for the basin was assumed to be 2 cubic feet per second per square mile, while loss rates were set at 1.0 inches initial abstraction and 0.1 inches/hour continuous loss rate. The loss rate function yielded 17.37 inches of runoff from 21.02 inches

precipitation. The PMF inflow hydrograph was determined by applying the PMP to the unit hydrographs and runoff and routing to the dam sites (Figure 4). The Probable Maximum Flood at the dam was 13,760 cfs, while the 1/2 Probable Maximum Flood was 7,046 cfs. The computed values are considered on average to be on the high side but are considered to be well with the screening criteria.

5.3 SPILLWAY CAPACITY

The dam contains only a service spillway consisting of two 42 inch iron pipes. No emergency spillway exists. The invert of the pipes are 7 feet below the top of the dam.

It is estimated that the spillway could discharge 400 cfs with the pool elevation at the top of the dam.

	<u>Discharge</u>	<u>Spillway Capacity</u>	<u>Depth of Flow Over Dam</u>
PMF	13,760	3%	8.16 ft.
1/2 PMF	7,046	6%	5.08 ft.

5.4 RESERVOIR CAPACITY

The reservoir capacity is given below.

Top of Dam	288 Acre Feet
Crest of Spillway	179 Acre Feet

The storage capacity curve is shown in Appendix C.

5.5 FLOODS OF RECORD

There is no information on water levels at the dam site.

5.6 OVERTOPPING POTENTIAL

The HEC1-DB analysis indicates that the dam will be overtopped as follows:

OVERTOPPING IN FEET

PMF	8.16
1/2 PMF	5.08

The downstream hazard is a lightly traveled road heading north out of the cantonment area. Should dam failure occur, this road would be overtopped to approximately the same depth of the dam overtopping.

5.7 EVALUATION

The limited spillway capacity and lack of an emergency spillway will result in overtopping of the dam for an event of less than the 1/2 Probable Maximum event. Therefore, the spillway is an inadequate spillway system on a Low Hazard Classification dam (for all flows beyond 6% of the Probable Maximum Flood).

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual inspection of the earthen dam indicates no evidence of a past stability failure, and no significant embankment cracking, sloughing or erosion was noted. A laid-up stone retaining wall utilized to form an upper part of the structure's downstream side (to support a widened roadway surface across the top of the dam) shows some evidence of settlement not seriously related to the embankment behavior. The section of concrete and masonry spillway extending through the dam appears structurally sound, but the masonry and concrete comprising the walls and apron of the downstream outlet area are deteriorating along with some washout. Seepage/leakage from the spillway outlet/embankment occurs at this location.

Tall trees exist at various locations on the downstream face and also the upstream face of the embankment. Brush, fallen trees and debris cover the embankment's downstream slope and downstream channel area.

A thin concrete facing applied to the stone retaining wall provided as support for the widened roadway passing over the dam is cracked and loosening at locations because of tree root penetration and frost and settlement affects. This concrete facing has no apparent relationship to the embankment stability, although it has probably assisted in keeping stone in place.

Almost the entire upstream face of the embankment is submerged when the reservoir is at spillway level. At the time of the field inspection, this upstream face was submerged and not visible for evaluation.

b. Geology and Seismic Stability

The St. James Lake area is located in the St. Lawrence Valley Lowland which is part of the eastern lake section of the Central Lowland Province. It is north of the Tug Hill Plateau and at the western edge of the Adirondack foothills.

The January 5, 1973 State Report indicates the dam was sited on clay and gravel and both the right and left banks are in clay. The January 31, 1923 State Engineer Report indicates the spillway to be on hardpan and gravel. The clay is a calcareous rich clay and is considered to be a glacial rock floor. This clay is subject to leaching and may be the reason for the suspected under or through-the-dam flow.

Bedrock beneath the clay in the area belongs to the Pamela Formation, the basal unit of the Black River Group (Middle Ordovician). The Pamela is a calcitic dolostone which has an average silica

content of about 13 percent. Sand content increases toward the base of the unit.

Cushing (1910, p. 133-134) mentions underground flow through limestone channels in the area. He also refers to roof cave in of these channels as being common. Cushing (1910, p. 143-144) also indicates that drainage of the large sand plain located to the south of St. James Lake and north of the Black River is northward into the Indian River.

Dip of bedrock in the area is 1° to 2° southwestward. The closest known fault to the dam is approximately 10 miles to the southeast. The arcuate shaped fault line trends northeast. A linear feature 3 miles north-northeast of the dam site and having an east-west trend and which might represent a fracture is shown on the 1977 Preliminary Brittle Structures Map of New York.

Between 1932 and 1963, five minor earthquakes were recorded 8 to 10 miles southwest of the dam site. None were of an intensity greater than III (modified Mercalli Scale). One earthquake of intensity VI was recorded 26 miles southeast of the dam in 1853. Though the area is located in Zone 3 of the Seismic Probability Map, it would more properly be designated Zone 2.

c. Data Review and Stability Evaluation

Records made available provide little indication about the materials of construction and actual method of placement. Though the existing structure is primarily earthen, correspondence from 1923 dealing with the then proposed construction for this dam indicate plans for a concrete spillway structure which apparently would constitute the entire dam. Presumably, the dam was widened and lengthened, and also raised a few feet in height, since the 1923 construction to reach the present dimensions.

The embankment section of the dam appears to be in good condition structurally. Repair of the concrete and masonry spillway's deteriorated downstream section, along with provisions to determine the course of and reduce on-going seepage at this general location, need be accomplished to prevent progressive deterioration and the related detrimental affect on the embankment's structural stability.

Corrective undertakings should include the cutting of trees on upstream and downstream slopes to eliminate the hazard of embankment damage where storms cause trees to uproot. Maintenance should extend to periodic removal of debris from the spillway area to reduce the danger that this outlet, of limited area, will become stopped.

The freeboard distance between the spillway level and the road surface along the top of the embankment is from one to two feet. Vegetation along the upstream freeboard would reduce erosion caused by normal wave action.

The dam and lake site lies in a Zone 3 Designation on the Seismic Probability Map although current recommendations revise the area to a Zone 2 Designation. Recent publications on the performance of earth dams during earthquakes implies that rolled earth embankments which include plastic, cohesive soils and are located on firm foundations (presumed for this structure) retain stability when subject to moderate earthquake forces. Affects of repeated shocks are not well established, however.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

This dam does not appear to present an immediate danger to life or property, however, the condition of the apron of the spillway and the seepage located at the wing wall of the spillway channel may increase with time and reduce the stability of this structure.

b. Adequacy of Information

The information available is inadequate for complete analysis of the dam. No information was available on the construction of the present facility. The only data collected regarding the design of the structure was that for a concrete dam presumably located at the present site.

c. Spillway Capacity

The existing spillway system has an outflow capacity of approximately 400 cfs. The 1/2 Probable Maximum Flood routed through the impoundment will produce a discharge of 7,046 cfs and will overtop the dam by approximately 5 feet. The capacity of the spillway is approximately 3 percent of the Probable Maximum Flood.

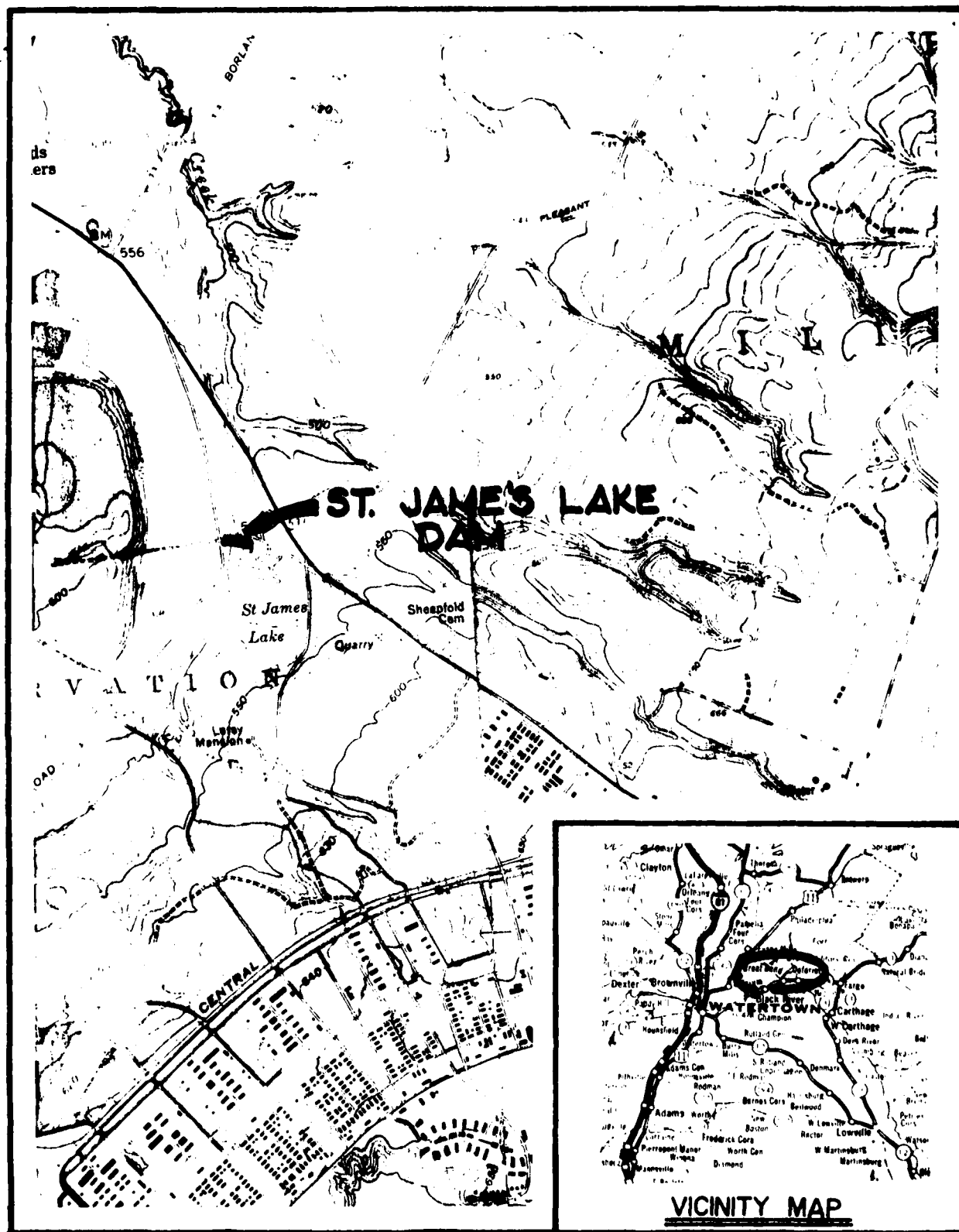
d. Stability

Since there is no information regarding the design or the construction of the existing facility, the determination of the stability of the structure can be assessed only on the basis of visual observation of the existing structure. There were no apparent structural defects that would affect the safety of the embankment.

7.2 RECOMMENDATIONS

- a. The discharge capacity of the spillway is inadequate for all flows in excess of 3 percent of the PMF (spillway capacity = 400 cfs). The spillway is not considered seriously inadequate based on the Corps of Engineers' screening criteria since the hydrologic/hydraulic analysis indicates that failure of the dam would not pose a high hazard to loss of life from large flows downstream from the dam. However, consideration should be given to provide an emergency spillway adequate to pass 1/2 of the PMF without damage to the structure. This may be accomplished by the construction of an emergency spillway on the undisturbed bank of the impoundment.
- b. The deteriorated apron of the existing service spillway should be repaired immediately.
- c. Investigations should be undertaken to determine the source of seepage noted near the wing wall of the existing spillway.

- d. The structural stability of the dam should be evaluated. This evaluation should be based on the data collected in a soils investigation program on the embankment section of the dam.
- e. An adequate warning system should be developed to be used in the event of potential failure or flooding.
- f. The trees and brush should be removed from both the upstream and downstream face of the embankment section. The unstream face should be protected from erosion by wave action by the placement of riprap at the waterline of the impoundment.
- g. A means should be provided for draining of the impoundment for inspection and/or maintenance procedures.



LOCATION PLAN

FIGURE 1

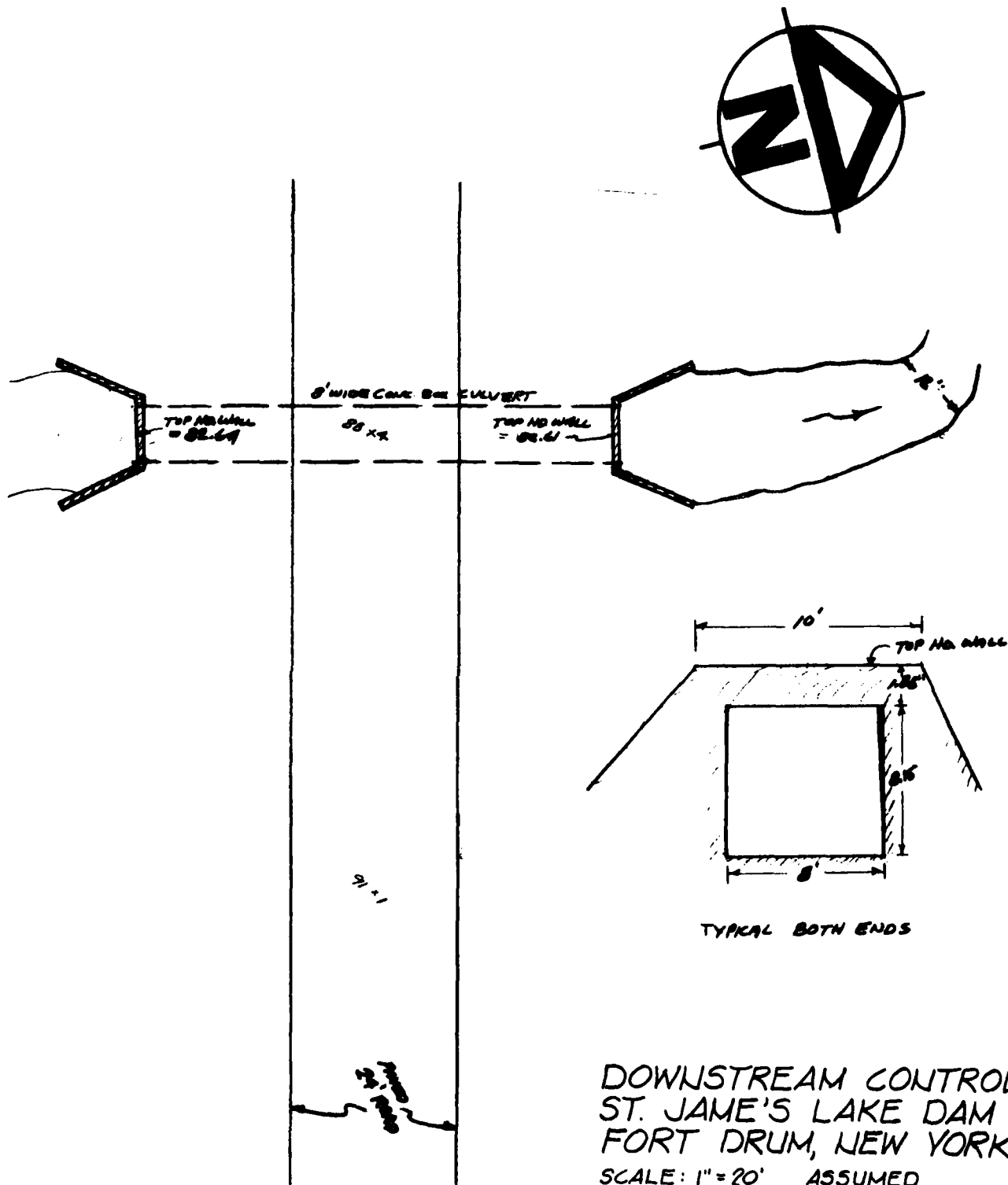
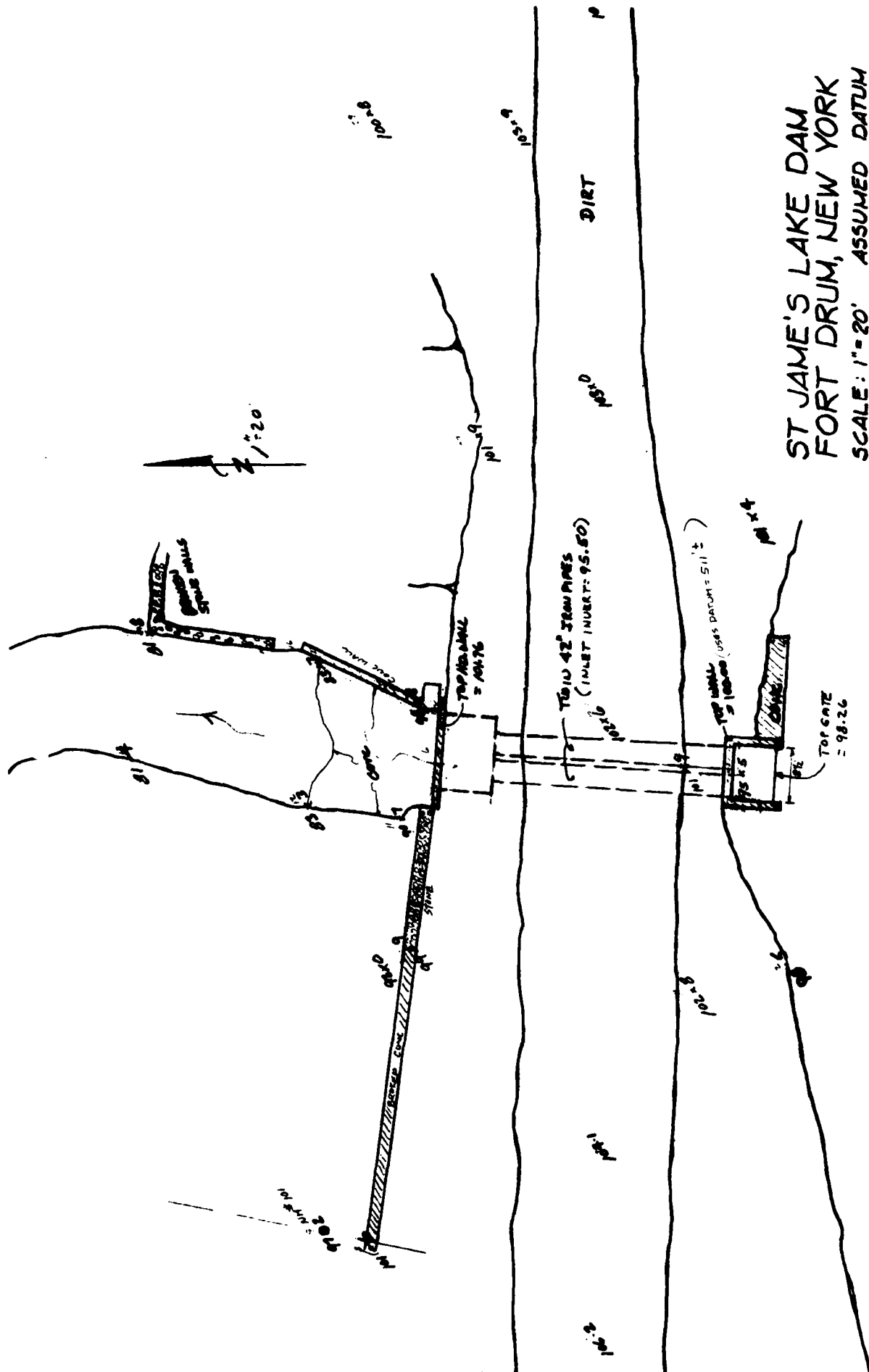


FIGURE 2

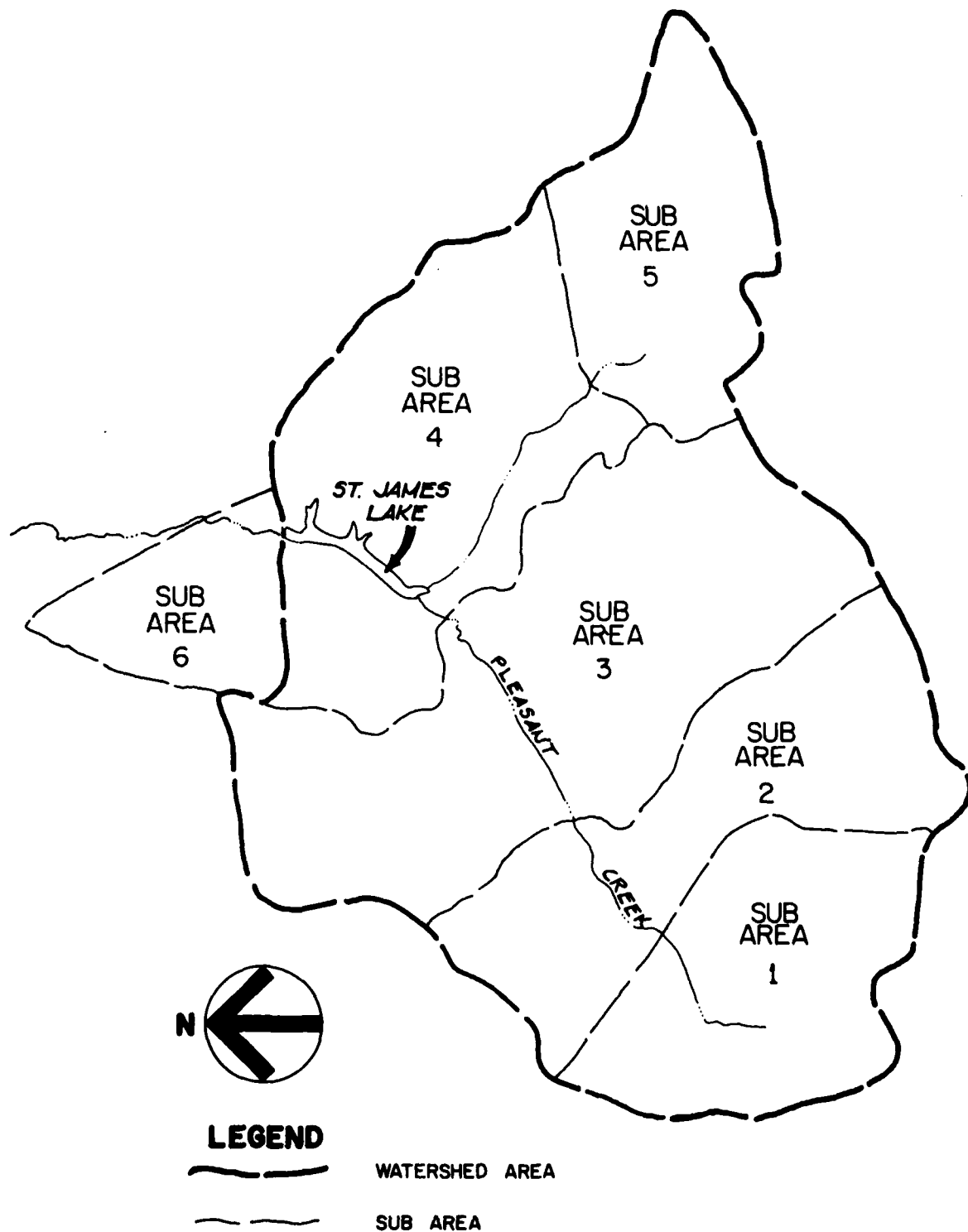


ST JAMES LAKE DAM
FORT DRUM, NEW YORK
SCALE: 1"=20' ASSUMED DATUM



LAKE ST JAMES

POND ELEV 4/27/79 = 98.5



DRAINAGE BASIN PLAN

FIGURE 4

APPENDIX A
FIELD INSPECTION REPORT

CHECK LIST
VISUAL INSPECTION

PHASE 1

Name Dam St. James Lake Dam County Jefferson State New York ID # 779
Type of Dam Earth Fill Hazard Category A - N.Y.S. Dam Inspection Report
Date(s) Inspection 5-2-79 Weather Fair Temperature 60-65 LOW HAZARD 5-29-75

Pool Elevation at Time of Inspection 98.5 Assumed Datum Tailwater at Time of Inspection ----

Inspection Personnel:

<u>N. Dunlevy</u>	<u>Stetson-Dale</u>
<u>D. McCarthy</u>	<u>Stetson-Dale</u>
<u>F.W. Byszewski</u>	<u>Stetson-Dale</u>
<u></u>	<u></u>

N. Dunlevy Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	No N/A.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	No N/A.	
DRAINS	No N/A.	
WATER PASSAGES	No N/A.	
FOUNDATION	No N/A.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A.	
STRUCTURAL CRACKING	N/A.	
VERTICAL & HORIZONTAL ALIGNMENT	N/A.	
MONOLITH JOINTS	N/A.	
CONSTRUCTION JOINTS	N/A.	
STAFF GAGE OF RECORDER	N/A.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No problems observed.	
RIPRAP FAILURES	No riprap.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems observed.	
ANY NOTICEABLE SEEPAGE	No East embankment toe area. Sub- stantial flow observed. Believed to be under-dam flow.	Should be investigated. If further seepage exists it should be repaired.
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Stop planks. Some spalling on head-wall and between steel pipe.	
APPROACH CHANNEL	Head of dam.	
DISCHARGE CHANNEL	Concrete lined channel beyond twin steel pipe culvert. Channel well graded.	Cavity at base of lined channel. 10 feet across and 3-4 feet high. Also crack in east headwall at downstream face of dam.
BRIDGE AND PIERS	Road over dam. No bridges or piers.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	None.	
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	None.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	See spillway.	
INTAKE STRUCTURE	See spillway.	
OUTLET STRUCTURE	See spillway.	
OUTLET CHANNEL	See spillway.	
EMERGENCY GATE	See spillway.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Obstructed with fallen trees, debris, and rocks.	
SLOPES	Flatly sloped.	
APPROXIMATE NO. OF HOMES AND POPULATION	None. Main road crossed below dam.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slightly graded terrain into reservoir.	
SEDIMENTATION	None observed.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE 1

NAME OF DAM St. James Lake Dam

ID #

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	See this report.
CONSTRUCTION HISTORY	No data.
TYPICAL SECTIONS OF DAM	See information prepared for this report.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	No data.
RAINFALL/RESERVOIR RECORDS	No data.

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Unknown. Some modification has taken place since original construction.
HIGH POOL RECORDS	No data.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	No data.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	No data.
MAINTENANCE OPERATION: RECORDS	No data.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	No data.
OPERATING EQUIPMENT PLANS & DETAILS	No data.

CHECK LIST
HYDROLOGIC & HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.137 square miles.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 511.0

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): ----

ELEVATION MAXIMUM DESIGN POOL: ----

ELEVATION TOP DAM: 517.0

CREST: Only spillway in a service spillway. No overflow emergency spillway.

a. Elevation 511.0

b. Type Weir drop inlet into twin 42 inch pipes.

c. Width ----

d. Length ----

e. Location Spillover Center of dam

f. Number and Type of Gates None

OUTLET WORKS: None

a. Type ----

b. Location ----

c. Entrance Inverts ----

d. Exit Inverts ----

e. Emergency Draindown Facilities ----

HYDROMETEOROLOGICAL GATES:

a. Type ----

b. Location ----

c. Records ----

MAXIMUM NON-DAMAGING DISCHARGE: ----

APPENDIX B

PREVIOUS INSPECTION REPORTS/RELEVANT CORRESPONDENCE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DAM INSPECTION REPORT
(By Visual Inspection)

Recreation pond
at Camp Drum

Dam Number	River Basin	Town	County	Hazard Class*	Date & Inspector
455	Oschic	Le Ray	Jefferson	A	5/29/75 GVE KH

Type of Construction

- ☐ Earth w/concrete spillway
☐ Earth w/drop inlet pipe
☒ Earth w/stone or riprap spillway
☐ Concrete
☐ Stone
☐ Timber

Use

- ☐ Water Supply
☐ Power
☒ Recreation
☐ Fish and Wildlife
☐ Farm Pond
☐ No Apparent Use-Abandoned

Estimated Impoundment Size

- ☒ 1-5 acres
☐ 5-10 acres
☐ Over 10 acres

Estimated Height of Dam above Streambed

- ☒ Under 10 feet
☐ 10-25 feet
☐ Over 25 feet

Condition of Spillway

- ☒ Service satisfactory
☐ In need of repair or maintenance
☐ Auxiliary satisfactory
☐ In need of repair or maintenance

Explain: _____

Condition of Non-Overflow Section

- ☒ Satisfactory
☐ In need of repair or maintenance Explain: _____

Condition of Mechanical Equipment

- ☐ Satisfactory
☐ In need of repair or maintenance Explain: _____

Evaluation (From Visual Inspection)

- ☒ No defects observed beyond normal maintenance
☐ Repairs required beyond normal maintenance

*Explain Hazard Class, if Necessary _____

ENVIRONMENTAL CONSERVATION
REPORT
(Inspection)

*Recreation Pond
at Camp Drum*

County	Hazard Class*	Date & Inspector
<i>Jefferson</i>	<i>A</i>	<i>8/29/75 BVE</i>

☐ Timber

Use

- ☐ Water Supply
☐ Power
☒ Recreation
☐ Fish and Wildlife
☐ Farm Pond
☐ No Apparent Use-Abandoned

Estimated Impoundment Size

- ☒ 1-5 acres
☐ 5-10 acres
☐ Over 10 acres

Estimated Height of Dam above Streambed

- ☒ Under 10 feet
☐ 10-25 feet
☐ Over 25 feet

Condition of Spillway

- ☒ Service satisfactory
☐ In need of repair or maintenance
☐ *None* Auxiliary satisfactory
☐ In need of repair or maintenance

Explain: _____

Condition of Non-Overflow Section

- ☒ Satisfactory
☐ In need of repair or maintenance

Explain: _____

Condition of Mechanical Equipment

- ☐ Satisfactory
☐ In need of repair or maintenance

Explain: _____

Evaluation (From Visual Inspection)

- ☒ No defects observed beyond normal maintenance
☐ Repairs required beyond normal maintenance

*Explain Hazard Class, if Necessary _____

STATE OF NEW YORK
DEPARTMENT OF
State Engineer and Surveyor
ALBANY

Received Jan 31st 1923 Dam No. 455 Haverghatish Watershed
Disposition _____ Serial No. _____
Site inspected _____
Foundation inspected _____
Structure inspected _____

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the State Engineer, Albany, N. Y., in compliance with the provisions of Chapter LXV of the Consolidated Laws and Chapter 647, Laws of 1911, Section 22 as amended, for the approval of specifications and detailed plans, marked _____

herewith submitted for the ~~construction~~ reconstruction of a dam located as stated below. All provisions of law will be complied with in the erection of the proposed dam.

1. The dam will be on _____ branch of _____ in the town of _____, County of _____ and _____

(Give exact distance and direction from a well-known bridge, dam, village, main cross-roads or mouth of a stream)

2. The name and address of the owner is _____
3. The dam will be used for _____
4. Will any part of the dam be built upon or its pond flood any State lands? _____
5. The watershed at the proposed dam draining into the pond to be formed thereby is _____ square miles.

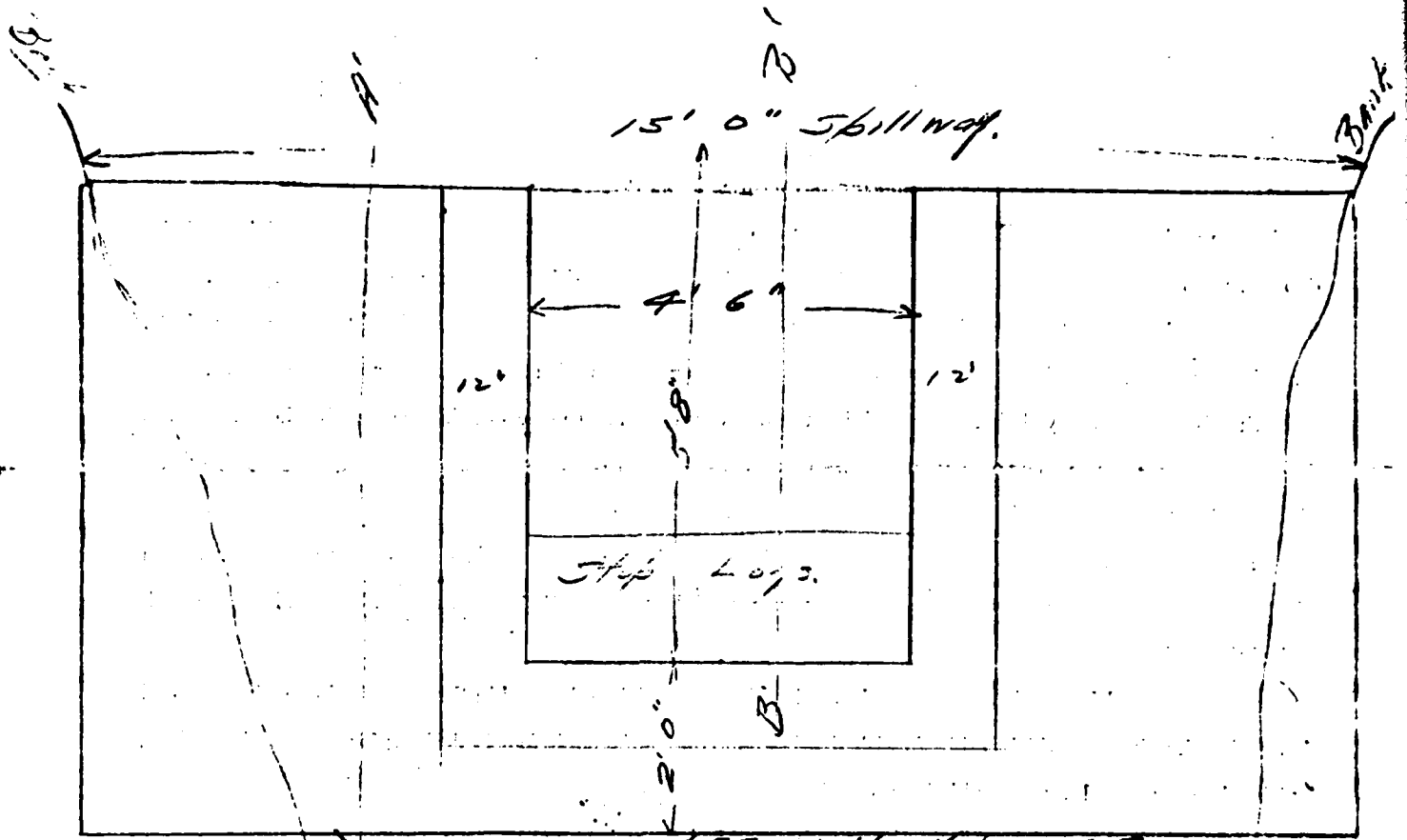
6. The proposed dam will have a pond area at the spillcrest elevation of _____ acres and will impound _____ cubic feet of water.

7. The lowest part of the natural shore of the pond is 3 feet vertically above the spillcrest, and everywhere else the shore will be at least 3 feet above the spillcrest.

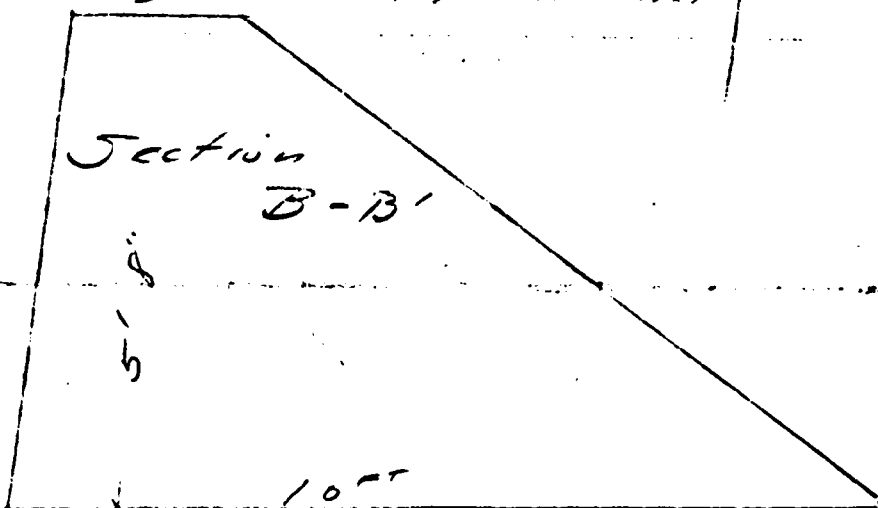
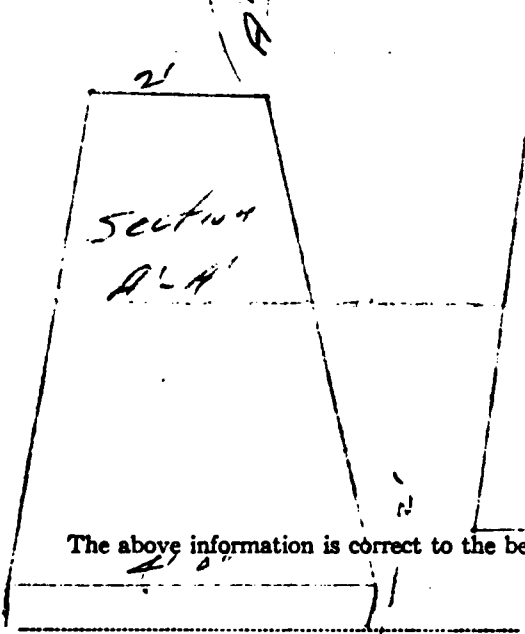
8. The maximum known flow of the stream at the dam site was _____ cubic feet per second on _____ (Date)

9. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam. _____

10. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) _____



5 FT HARD PAN & GRAVEL



The above information is correct to the best of my knowledge and belief.

(Address of signer)

(Date)

Frank Hilburn

W. C. T. M. M. M.

(A person signing for Applicant should indicate his title or authority).

STATE OF NEW YORK
DEPARTMENT OF
State Engineer and Surveyor
ALBANY

Received Jan 5th 1922 Dam No. 455 Oswegatchie Watershed
Disposition _____ Serial No. 489
Site inspected _____
Foundation inspected _____
Structure inspected _____

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the State Engineer, Albany, N. Y., in compliance with the provisions of Chapter LXV of the Consolidated Laws and Chapter 647, Laws of 1911, Section 22 as amended, for the approval of specifications and detailed plans, marked no plans or specifications

herewith submitted for the construction of a dam located as stated below. All provisions of law will be complied with in the erection of the proposed dam.

1. The dam will be on branch of Pleasant Creek in the town of Le Roy, County of Jefferson and about 1/8 mile from Le Royville & 700 S E of County Road
(Give exact distance and direction from a well-known bridge, dam, village, main cross-roads or mouth of a stream)
2. The name and address of the owner is Frank Shittell - Watertown N.Y.
3. The dam will be used for Fish pond
4. Will any part of the dam be built upon or its pond flood any State lands? no
5. The watershed at the proposed dam draining into the pond to be formed thereby is a few acres square miles.
6. The proposed dam will have a pond area at the spillcrest elevation of one 8 feet deep acres and will impound _____ cubic feet of water.
7. The lowest part of the natural shore of the pond is level with feet vertically above the spillcrest, and everywhere else the shore will be at least level feet above the spillcrest.
8. The maximum known flow of the stream at the dam site was _____ cubic feet per second on _____
(Date) very small
9. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam. none
10. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) clay & gravel

11. The material of the right bank, in the direction with the current, is clay; at the spillcrest elevation this material has a top slope of inches vertical to a foot horizontal on the center line of the dam, a vertical thickness at this elevation of feet, and the top surface extends for a vertical height of feet above the spillcrest.

12. The material of the left bank is clay; has a top slope of inches to a foot horizontal, a thickness of feet, and a height of feet.

13. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. hard

14. If the bed is in layers, are the layers horizontal or inclined? If inclined what is the direction of the slope relative to the center line of the dam and the inches vertical to a foot horizontal?

15. What is the thickness of the layers?

16. Are there any porous seams or fissures? no

17. WASTES. The spillway of the above proposed dam will be 4.6 feet long in the clear; the waters will be held at the right end by a concrete dam the top of which will be 2 feet above the spillcrest, and have a top width of 3 feet; and at the left end by a concrete dam the top of which will be 2 feet above the spillcrest, and have a top width of 3 feet.

18. There will be also for flood discharge a pipe inches in diameter and the bottom will be feet below the spillcrest, a sluice or gate feet wide in the clear by feet high, and the bottom will be feet below the spillcrest. Plank gates

19. APRON. Below the proposed dam there will be an apron built of concrete, 10 feet long, 4.6 feet wide and 1 feet thick. The downstream side of the apron will have a thickness of feet for a width of feet.

20. PLANS. Each application for a permit of a dam over 12 feet in height must be accompanied by a location map and complete working drawings of the proposed structure. Each drawing should have a title giving the parts shown, the name of the town and county in which the dam site is located, and the name of the owner and of the engineer.

The location map (U. S. Geological Quadrangle or other map) should show the exact location of the proposed dam; of buildings below the dam which might be damaged by any failure of the dam; of roads adjacent to or crossing the stream below the dam, giving the lowest elevation of the roadway above the stream bed and giving the shape, the height and the width of stream openings; and of any embankments or steep slopes that any flood could pass over. Also indicate the character and use made of the ground.

The complete working drawings should give all the dimensions necessary for the calculations of the stability of the structure, and all the information asked for below under "Sketches." There may be attached to the plans any written reports, calculations, investigations or opinions that may aid in showing the data and method used by the designer.

21. **SKETCHES.** For small and unimportant structures, if plans have not been made, on the back sheet of this application make a sketch to scale for each different cross-section at the highest point; showing the height and the depth from the surface of the foundation, the bottom width, the top width (for a concrete or masonry spill at 18 inches below the crest), the elevation of the top in reference to the spillcrest, the length of the section, and the material of which the section is to be constructed. Mark each section with a capital letter. Also sketch a plan; show the above sections by their top lines, giving the mark and the length of each; the openings by their horizontal dimensions; and the abutments by their top width and top lengths from the upstream face of the spillcrest and give the elevation of the top in reference to the spillcrest.

22. **ELEVATIONS.** Also give the elevations, if possible from the Mean Sea Level, of at least two permanent Bench Marks; of the spillcrest for any existing dam on the proposed dam site, at the middle and at both ends of the spill; and of the spillcrest for the above proposed dam.

23. **SAMPLES.** When so instructed, send samples of the materials to be used in the construction of the proposed dam, using shipping tags which will be furnished. For sand one-half a cubic foot is desired; for cement, three pints; and for the natural bed, twenty cubic inches.

24. **INSPECTION.** State how inspection is to be provided for during construction. *By owner*

I, the undersigned, do hereby certify that the above information is correct to the best of my knowledge and belief.

Witness my hand and seal this _____ day of _____, 1923.

I, the undersigned, do hereby certify that the above information is correct to the best of my knowledge and belief.

I, the undersigned, do hereby certify that the above information is correct to the best of my knowledge and belief.

I, the undersigned, do hereby certify that the above information is correct to the best of my knowledge and belief.

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I, the undersigned, do hereby certify that the above information is correct to the best of my knowledge and belief.

I, the undersigned, do hereby certify that the above information is correct to the best of my knowledge and belief.

The above information is correct to the best of my knowledge and belief.

608 Davidson St
Watertown, Mass.
(Address of signer)

Jan 3 1923
(Date)

Frank Hibbard

(A person signing for Applicant should indicate his title or authority).



AMMOK-F.

February 1, 1923.

Dam 455, Oswegatchie,
Leraysville.

Hon. John F. Carlisle,
P. O. Box 18,
Watertown, N. Y.

Dear Sir:

We have received your letter of January 29th, enclosing a second application for the construction of a dam known on our records as No. 455, Oswegatchie Watershed.

The dam will be on a tributary to Pleasant creek, which tributary crosses the county road to Philadelphia and Antwerp at a distance of 1/2 mile northeast from Leraysville four corners, and the dam will be 700 feet above the crossing.

As the area draining into the pond to be formed by the proposed dam will not exceed one square mile; as the dam is but 7'-8" above the natural bed of the stream; as probably the dam does not impound 1,000,000 gallons of water, and as you state in the application received on January 5th, that no possible failure of the proposed dam could do any damage to life, or to buildings, roads, or other property, therefore, in our judgment it is not necessary to prescribe any conditions for safeguarding life and property against danger therefrom, and insofar as the matter concerns the jurisdiction conferred upon this office by Chapter LXV of the Consolidated Laws and Chapter 647 of the Laws of 1911, Section 22, you may complete the work described in the two applications.

This approval shall not be deemed to authorize any invasion of property rights, either public or private, in carrying out the above work; nor to create any claim against the State of New York; nor to be considered as authorizing the flooding of State lands, nor as acquiescing in the flooding of such lands; nor to waive any requirement of Article IX of the Conservation Law relating to water supply.

Very truly yours,

.....
Deputy State Engineer.

ALEXANDER MACDONALD
COMMISSIONER
C. FRASER STAGG
DEPUTY COMMISSIONER
ROBERT F. PRESCOTT
SECRETARY

STATE OF NEW YORK



CONSERVATION COMMISSION

ALBANY

DIVISION OF FISH AND GAME
LLEWELLYN LEGGE, CHIEF
DIVISION OF LAND AND FORESTS
C. W. PETTIS, SUPERINTENDENT
DIVISION OF SARATOGA SPRINGS
J. G. JONES, SUPERINTENDENT
SARATOGA SPRINGS, N. Y.

IN REPLYING PLEASE REFER
TO FILE NO.

February 5, 1923.

Hon. Dwight B. Ladd,
State Engineer,
Albany, N. Y.

ATTENTION OF MR. ARNOLD CHAPMAN

Dear Sir:-

I am directed by Commissioner Macdonald to acknowledge receipt of your letter of February 2nd addressed to him, making inquiry as to whether the Commission will require a fishway in a dam which is to be constructed by Mr. Frank Hibbard, Watertown, N. Y., on a tributary to Pleasant Creek.

In reply we would advise you that the Commission will not require the placing of a fishway in this dam at the present time, reserving the right, however, to have such fishway placed in the dam in the future if we believe it necessary.

Very truly yours,

Alexander Macdonald, Commissioner.

37

John T. McCormick
Deputy Chief, D.P.C.C.

J.T.C.

B-11

ARLICK-F.

February 2, 1923.

Dam No. 455, Oswegatchie
Watershed.

Hon. Alexander Macdonald,
Conservation Commissioner,
Albany, N. Y.

Dear Sir:

Mr. Frank Hibbard of Watertown, N. Y., wishes to erect
a concrete dam approximately 8 feet high, which will be on a
tributary to Pleasant creek, which tributary crosses the county
road from Leraysville to Philadelphia and at a distance 1/2 mile
northeast from Leraysville four corners. The dam will be 700 ft.
above the crossing, and its location is shown on U. S. G. S. Sheet
No. 88. Will this dam require a fishway?

Very truly yours,

.....
Deputy State Engineer.

Office of the President

Northern New York Utilities, Inc.

John N. Carlisle

Watertown, N. Y.

Jan. 29, 1923.

Hon. Dwight B. LaDu,
State Engineer's Office,
Albany, N. Y.

RECEIVED
AND

Dam No. 455, Oswegatchie-LeRaysville.

Dear Sir:-

I have your favor of January 5th acknowledging receipt of my letter of January 4th, concerning the construction of a dam half a mile northeast of LeRaysville Four Corners, and in accordance with your request I am returning you the application which ^{you} sent ^{me} ~~you~~ with the sketch on the back thereof, and which I trust will give you the information you desire. This sketch should be attached to the other application which I sent you in my letter of January 4th, and that contained the other information.

As I understand, you grant the licenses in connection with these matters, and as I wrote you before, this is a very small dam and could possibly result in no damages, and I am simply doing the work for an old friend of mine, who is trying to establish a trout pond.

Yours very truly,



JNC/B
Encl.

AMMOK-P.

January 5, 1920.

Dam No. 455, Oswegatchie,
Lerayville.

Hon. John H. Carlisle,
P. O. Box No. 18,
Watertown, N. Y.

Dear Sir:

We have received your letter of January 4th, concerning the construction of a dam half a mile northeast of Lerayville Four Corners.

On the enclosed application kindly make the sketches requested in section 21. On the spillway section show a cross section of the apron with its width, thickness and material, and show the abutment or wash wall at the end of the spillway, giving its height and thickness. Also sketch the elevation of the ends of the dam with cross section of banks, giving the depth and width excavated into the banks. On the plan outline the apron, giving its length.

Very truly yours,

.....
State Engineer.

Enclosure.

Office of the President

Northern New York Utilities, Inc.

John N. Carlisle

Watertown, N.Y.

Jan. 4, 1923.

Proposed dam at
Leraysville and
Evans Mills.

ARMCK-M

Hon. D. B. LaDue,
State Engineer & Surveyor,
Albany, N. Y.

Dear Sir:-

In reference to proposed matter, I have the
favor of your office of December 28th, asking us to fill
out an application blank in connection with the construction
of a dam by Mr. Frank Hibbard.

I am returning the U. S. Geological Survey sheet
and questionnaire filled out.

You will notice this is a very small matter, and
one that could possibly affect no one. If there is any
further information about the matter, kindly take it up
with me and I will be glad to give you any further details
you may want.

Yours very truly,



JNC/B
Encl.

B-15

ATTCH-H

Proposed Dam at
Jerseyville and Evans
Hill:
455 *Carrollton*

December 14, 1900.

Hon. John W. Carlisle,
P.O. Box 11,
Saratoga, N.Y.

Dear Sir:

Your letter of November 26th received stating that Mr. Frank Hibbard of Saratoga wishes to construct a dam between Jerseyville and Evans Hill. We enclose herewith U.S. Geological Survey sheet No. 25 on which we ask you to mark the exact location of the dam. The scale of the map is one inch to the mile.

Kindly fill out one of the enclosed applications and submit to this office for approval of the work, making the sketches as requested under Section 1 of the application, and on the spillway section show a cross section of the apron with its width, thickness and material; showing the abutment of wash wall at the end of the spillway, giving its width and thickness. Also sketch the elevation of the ends of the dam with cross section of the banks, giving the depth and width excavated into the banks. Or if plans are drawn, there should be duplicate prints sent to this department, one of which will be returned if they meet with our approval.

Yours very truly,

WILLIAM A. HILL
State Engineer,

BY

ASST. Engr. Deputy.

Enclosures.

B-16

Office of the President

Northern New York Utilities, Inc.

John N. Carls

Watertown, N.Y.

Dec. 26, 1922.

Alexander Rice McKim, Esq.,
State Conservation Commission,
Albany, N. Y.

My dear Mr. McKim:-

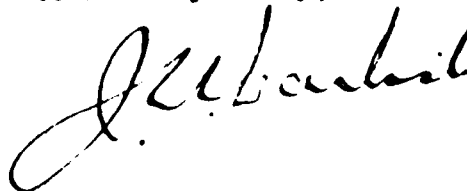
Mr. Frank Hibbard of this city is the owner of a small pond between Leraysville and Evans Mills in this county, and in order to make a trout preserve he has put in a small piece of concrete where there was an old crib dam, and the pond altogether is about an acre and a quarter and the water is about seven feet deep.

He called to see me today, and said that he had been informed that some inspectors, probably from your department, had been up there and stated that he had no right to erect this dam without the approval of your department.

I have known Mr. Hibbard a long while, and he certainly did not intend to do anything contrary to the rules of your department, and of course knew nothing about the law itself. He does not intend to create any power at that place, and I am enclosing you a photograph that shows just what work he has done. Possibly he ought to file some kind of an application with you and have somebody come up, and if you will let me know just what course he ought to pursue, he will be glad to comply with any of your regulations. You can write me direct and I will take it up with him.

There was an old crib dam for years at this place but it went out about six or seven years ago, and the old crib dam has been there for over one hundred years. You will see by the photograph that it is a very small matter, but he wants of course to comply with any regulations necessary.

Yours very truly,



JNC/B
Encl.

APPENDIX C

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



STETSON • DALE

BANKERS TRUST BUILDING
UTICA • NEW YORK • 13501
TEL 315-797-5800

DESIGN BRIEF

PROJECT NAME NEW YORK STATE DAM INSPECTION DATE 5-1-79
 SUBJECT ST. JAMES LAKE DAM (FORT DRUM, NY) PROJECT NO. 2277
ESTIMATE OF CLARK'S PARAMETERS DRAWN BY JPG

ESTIMATE OF T_c ASSUME: $R/(T_c + R) = .$

$$\therefore R = T_c *$$

$$T_c = 11.9 (L^3/H)^{.385}$$

		<u>L (MI)</u>	<u>H (FT)</u>	<u>T_c (Hrs) & R</u>
SUB AREA	1	.852	95	1.713
"	2	.568	100	1.052
"	3	.795	140	1.362
"	4	.663	155	1.062
"	5	1.136	50	3.058
"	6	.341	120	.544

SCS

$$L = \frac{I^2 (S+1)^7}{1900 Y^{.5}}$$

$$T_c = L/6$$

		<u>I (FT)</u>	<u>S</u>	<u>Y (%)</u>	<u>L (Hrs)</u>	<u>T_c (Hrs) & R</u>
SUB AREA	1	4500	3.89	5	.598	.99
"	2	3000	4.49	7	.396	.66
"	3	4200	4.08	7	.491	.82
"	4	3500	4.92	8	.442	.74
"	5	6000	1.76	4	.564	.94
"	6	1800	3.89	8	.227	.38

CN COMPUTATIONS

SUB AREA 2: $85 \times 15 = 1275$

$$66 \times 85 = 5610$$

$$6885 \div 10 = 69$$

SUB AREA 3: $85 \times 24 = 2040$

$$66 \times 76 = 5016$$

$$7056 \div 10 = 71$$

SUB AREA 4: $85 \times 14 = 1190$

$$66 \times 86 = 5676$$

$$6866 \div 10 = 69$$

* NORTH ATLANTIC REGIONAL
WATER RESOURCES STUDY - FEBRUARY 1972



STETSON • DALE

BANKERS TRUST BUILDING
UTICA • NEW YORK • 13501
TEL 315-797-5800

DESIGN BRIEF

PROJECT NAME NEW YORK STATE DAM INSPECTION DATE 5.1.79
 SUBJECT ST JAMES LAKE DAM (FORT DRUM, NY) PROJECT NO. 2277
ESTIMATE OF SNYDER'S PARAMETER DRAWN BY JPS

640 C_p

	<u>C_p</u>
SUB AREA 1	.625
" " 2	.625
" " 3	.625
" " 4	.625
" " 5	.625
" " 6	.625

$$t_p = C_t (L \cdot L_c)^{.3}$$

	<u>C_t</u>	<u>L (m)</u>	<u>L_c (m)</u>	<u>t_p</u>
SUB AREA 1	2.0	.852	.378	1.424
" " 2	2.0	.568	.426	1.307
" " 3	2.0	.795	.473	1.491
" " 4	2.0	.663	.568	1.492
" " 5	2.0	1.136	.568	1.754
" " 6	2.0	.341	.284	.993

t_r = t_p / 5.5

	<u>t_p</u>	<u>t_r</u>
SUB AREA 1	1.424	.259
" " 2	1.307	.238
" " 3	1.491	.271
" " 4	1.492	.271
" " 5	1.754	.319
" " 6	.993	.181

t_{pr} = t_p + .25 (t_r - t_r)

	<u>t_p</u>	<u>t_r</u>	<u>t_r</u>	<u>t_{pr}</u>
SUB AREA 1	1.424	1.0	.259	1.61
" " 2	1.307	1.0	.238	1.50
" " 3	1.491	1.0	.271	1.67
" " 4	1.492	1.0	.271	1.67
" " 5	1.754	1.0	.319	1.92
" " 6	.993	1.0	.181	1.20



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TEL 315-797-5800

DESIGN BRIEF

PROJECT NAME NEW YORK STATE DAM INSPECTION DATE 5.3.79
SUBJECT ST JAME'S LAKE DAM (FORT DRUM, NY) PROJECT NO. 2277
DEPTH - DURATION RELATIONSHIP DRAWN BY JPG

HYDROMETEOROLOGICAL REPORT N° 33

PMP INDEX RAINFALL

200. SQ MI

24 HR - 18.5"

DURATION

%

DEPTH

6 HR

111

20.54

12 HR

123

22.76

24 HR

133

24.61

48 HR

142

26.50

ST JAMES LAKE - STA. 5 (BELOW DAM)

2277

STAGE DISCHARGE CALCULATIONS

by AMS

5/18/79

SUMMARY

HEIGHT ABOVE CULVERT INVERT. (FT)	TOTAL DISCHARGE (CFS)	
0	0	
1	25	
2	70	
3	125	MANNING FLOW WITH ASSUMED SLOPE (UNABLE TO VERIFY)
4	185	
5	250	
6	360	
7	440	
8	500	ASSUMED INLET CONTROL GOVERNS CULVERT FLOW (UNABLE TO VERIFY)
9	600	
10	700	
11	800	
12	850	
13	980	EMBANKMENT OVERTOPPED
14	1470	
15	2345	
16	3680	
CULVERT INVERT = 72.64' (±)	5260	
MINIMUM EMBANKMENT	7410	
BLEV. = 84.8' ±	9900	
	12,770	
	15,980	

C-4

①

for $h = 1'$, elev = 73.64', flow through culvert only

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$$S = \frac{.08}{70} = .001143, \text{ let } S = .001 \therefore S^{1/2} = .032$$

$$A = 1' \times 8' = 8 \text{ ft}^2$$

$$R = \frac{A}{P} = \frac{8 \text{ ft}^2}{10'} = .80, R^{2/3} = .86$$

$$= 8 \text{ ft}^2 \times \frac{1.49}{.013} \times .86 \times .032 = 25.2 \text{ cfs} \approx \underline{\underline{25^{\pm} \text{ cfs}}}$$

for $h = 2'$, elev = 74.64'

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$$A = 2 \times 8' = 16 \text{ ft}^2$$

$$R = \frac{A}{P} = \frac{16}{12} = 1.33, R^{2/3} = 1.21$$

$$= 16 \text{ ft}^2 \times \frac{1.49}{.013} \times 1.21 \times .032 = 70.9 \approx \underline{\underline{70^{\pm} \text{ cfs}}}$$

for $h = 3'$, elev = 75.64'

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$$A = 3 \times 8' = 24 \text{ ft}^2$$

$$R = \frac{A}{P} = \frac{24}{14} = 1.71, R^{2/3} = 1.43$$

$$= 24 \times \frac{1.49}{.013} \times 1.43 \times .032 = 126 \approx \underline{\underline{125^{\pm} \text{ cfs}}}$$

for $h = 4'$, elev = 76.64

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$$A = 4 \times 8 = 32$$

$$R = \frac{32}{16} = 2.0, R^{2/3} = 1.59$$

$$= 32 \times \frac{1.49}{.013} \times 1.59 \times .032 = 186 \approx \underline{\underline{185^{\pm} \text{ cfs}}}$$

for $h = 5'$, elev = 77.64

$$Q = VA = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

$$A = 5 \times 8 = 40$$

$$R = \frac{40}{18} = 2.22, R^{2/3} = 1.70$$

$$= 40 \times \frac{1.49}{.013} \times 1.70 \times .032 = 249 \approx \underline{\underline{250^{\pm} \text{ cfs}}}$$

C-5

(2)

for $h = 6'$, elev 78.64

switch to fig. 3, assume inlet control beginning to govern at this flat gradient.

$$\text{for } HW/S_p = 6/8.15 = .74, \quad Q = 45 \text{ cfs/ft} \\ = \underline{\underline{360 \text{ cfs}}}$$

for $h = 7'$, elev 79.64

$$\text{for } HW/S_p = 7/8.15 = .86, \quad Q = 55 \text{ cfs/ft} \\ = \underline{\underline{440 \text{ cfs}}}$$

for $h = 8'$, elev 80.64

$$\text{for } HW/S_p = 8/8.15 = .98, \quad Q = 63 \text{ cfs/ft} \\ = 504 \text{ cfs} \approx \underline{\underline{500 \text{ cfs}}}$$

for $h = 9'$, elev 81.64

$$\text{for } HW/S_p = 9/8.15 = 1.10, \quad Q = 75 \text{ cfs/ft} \\ = \underline{\underline{600 \text{ cfs}}}$$

for $h = 10'$, elev 82.64

$$\text{for } HW/S_p = 10/8.15 = 1.23, \quad Q = 87 \text{ cfs/ft} \\ = \underline{\underline{700 \text{ cfs}}}$$

for $h = 11'$, elev 83.64

$$\text{for } HW/S_p = 11/8.15 = 1.35, \quad Q = 99 \text{ cfs/ft} \\ = \underline{\underline{800 \text{ cfs}}}$$

C-D

(3)

for $h = 12'$, elev 84.6 (no overtopping yet)

$$\text{for } HW/s_p = 12/8.15 = 1.47, \quad Q = 106 \text{ cfs/ft} \\ = \underline{\underline{850 \text{ cfs}}}$$

for $h = 13'$, elev = 85.6 (embankment overtopped by .8')

$$\text{culvert; for } HW/s_p = 13/8.15 = 1.60, \quad Q = 113 \times 8 = 900 \text{ cfs}$$

$$\text{weir; } Q_w = \sum CLH^{3/2} = 1.45 [40 \times .2^{3/2} + 100 \times .6^{3/2} + 50 \times .2^{3/2}] \\ = 1.45 [3.6 + 46.5 + 4.5] = 79.2 = 80 \text{ cfs}$$

$$Q_{\text{Tot}} = Q_w + Q_c = 900 + 80 = \underline{\underline{980 \text{ cfs}}}$$

for $h = 14'$, elev = 86.6 (overtopped by 1.8')

$$\text{culvert, for } HW/s_p = 14/8.15 = 1.72, \quad Q = 121 \times 8 \approx 970 \text{ cfs}$$

$$\text{weir; } Q = \sum CLH^{3/2} = 1.45 [35 \times .3^{3/2} + 50 \times 1.1^{3/2} + 100 \times 1.6^{3/2} \\ + 50 \times 1.2^{3/2} + 40 \times .5^{3/2}] = 1.45 [5.6 + 57.7 + 202.4 + \\ 65.7 + 14.1] = 501 = 500 \text{ cfs}$$

$$Q_{\text{Tot}} = Q_w + Q_c = 970 + 500 = \underline{\underline{1470 \text{ cfs}}}$$

for $h = 15'$, elev = 87.6 (overtopped by 2.8')

$$\text{culvert, for } HW/s_p = 15/8.15 = 1.84, \quad Q = 129 \times 8 = 1030 \text{ cfs}$$

$$\text{weir, } Q = \sum CLH^{3/2} = 1.45 [30 \times .4^{3/2} + 50 \times 1.3^{3/2} + 50 \times 2.1^{3/2} + 100 \times 2.6^{3/2} \\ + 50 \times 2.2^{3/2} + 50 \times 1.4^{3/2} + 30 \times .5^{3/2}] \\ = 1.45 [7.6 + 70.3 + 152.2 + 419.2 + 163.2 + 82.8 + 10.6] \\ = 1314 \text{ cfs} = 1315 \text{ cfs}$$

$$Q_{\text{Tot}} = Q_w + Q_c = 1030 + 1315 = \underline{\underline{2345 \text{ cfs}}}$$

(4)

for $h = 16'$, elev = 88.6 (overtopping by 3.8')

culvert ; for $HW/s_p = 16/8.15 = 1.96$ $Q = 135 \times 8 = 1080$

$$\begin{aligned} \text{weir ; } Q &= \sum CLH^{3/2} = 1.45 \left[20 \times .1^{3/2} + 50 \times 1.2^{3/2} + 50 \times 2.2^{3/2} + 50 \times 3.1^{3/2} \right. \\ &\quad \left. + 100 \times 3.6^{3/2} + 50 \times 3.2^{3/2} + 50 \times 2.4^{3/2} + 50 \times 1.2^{3/2} + 20 \times .2^{3/2} \right] \\ &= 1.45 \left[.6 + 65.7 + 163.2 + 272.9 + 683.1 + 286.2 + 185.9 + \right. \\ &\quad \left. 67.2 + 1.8 \right] = 2504 \approx 2500 \text{ cfs} \end{aligned}$$

$$Q_{\text{TOT}} = Q_{\text{cu}} + Q_{\text{w}} = 1080 + 2500 = \underline{\underline{3680 \text{ cfs}}}$$

for $h = 17'$, elev = 89.6 (overtopping by 4.8')

culvert ; for $HW/s_p = 17/8.15 = 2.09$ $Q = 140 \times 8 = 1120 \text{ cfs}$

$$\begin{aligned} \text{weir ; } Q_{\text{w}} &= \sum CLH^{3/2} = 1.45 \left[10 \times .1^{3/2} + 50 \times .9^{3/2} + 50 \times 2.2^{3/2} + 50 \times 3.2^{3/2} \right. \\ &\quad \left. + 50 \times 4.1^{3/2} + 100 \times 4.6^{3/2} + 50 \times 4.2^{3/2} + 50 \times 3.4^{3/2} + 50 \times 2.2^{3/2} + 40 \times 1.2^{3/2} \right] \\ &= 1.45 \left[.3 + 42.7 + 163.2 + 286.2 + 415.1 + 986.6 + 430.4 + \right. \\ &\quad \left. 313.5 + 163.2 + 52.6 \right] = 4138 \approx 4140 \text{ cfs} \end{aligned}$$

$$Q_{\text{TOT}} = Q_{\text{c}} + Q_{\text{w}} = 1120 + 4140 = \underline{\underline{5260 \text{ cfs}}}$$

for $h = 18'$, elev = 90.6 (overtopping by 5.8')

culvert, for $HW/s_p = 18/8.15 = 2.20$ $Q = 149 \times 8 = 1190 \text{ cfs}$

$$\begin{aligned} \text{weir ; } Q_{\text{w}} &= \sum CLH^{3/2} = 1.45 \left[35 \times .6^{3/2} + 50 \times 1.9^{3/2} + 50 \times 3.2^{3/2} + 50 \times 4.2^{3/2} \right. \\ &\quad \left. + 50 \times 5.1^{3/2} + 100 \times 5.6^{3/2} + 50 \times 5.2^{3/2} + 50 \times 4.4^{3/2} + 50 \times 3.2^{3/2} + 50 \times 2.4^{3/2} \right. \\ &\quad \left. + 15 \times .1^{3/2} \right] = 1.45 \left[16.3 + 130.9 + 286.2 + 430.4 + \right. \\ &\quad \left. 575.9 + 1325.2 + 592.9 + 461.5 + 286.2 + 185.9 + .5 \right] \\ &= 6223 \pm \end{aligned}$$

$$Q_{\text{TOT}} = Q_{\text{c}} + Q_{\text{w}} = 1190 + 6220 = 7410 \text{ cfs}$$

CB

(5)

for $h = 19'$, elev = 91.6 (overtopping by 6.8')

culvert; for $HW/S = 19/8.15 = 2.33$, $Q = 152 \times 8 = 1210$ cfs

$$\begin{aligned} \text{weir; } Q_w = \sum CLH^{3/2} &= 1.45 \left[10 \times 1^{3/2} + 50 \times 1.5^{3/2} + 50 \times 2.9^{3/2} + 50 \times 4.2^{3/2} + \right. \\ &50 \times 5.2^{3/2} + 50 \times 6.1^{3/2} + 100 \times 6.6^{3/2} + 50 \times 6.2^{3/2} + 50 \times 5.4^{3/2} + 50 \times 4.2^{3/2} \\ &+ 50 \times 3.4^{3/2} + 40 \times 1^{3/2} \left. \right] = 1.45 [.3 + 91.9 + 246.9 + 430.4 + \\ &592.9 + 753.3 + 1695.6 + 771.9 + 627.4 + 430.4 + 313.5 + \\ &40] = 8691 \end{aligned}$$

$$Q_{TOT} = Q_c + Q_w = 1210 + 8690 = \underline{\underline{9900 \text{ cfs}}}$$

for $h = 20'$, elev = 92.6 (overtopping by 7.8')

culvert; for $HW/S_p = 20/8.15 = 2.45$, $Q = 160 \times 8 = 1280$

$$\begin{aligned} \text{weir; } Q_w = \sum CLH^{3/2} &= 1.45 \left[25 \times .7^{3/2} + 50 \times 2.4^{3/2} + 50 \times 3.9^{3/2} + 50 \times 5.2^{3/2} + \right. \\ &50 \times 6.2^{3/2} + 50 \times 7.1^{3/2} + 100 \times 7.6^{3/2} + 50 \times 7.2^{3/2} + 50 \times 6.4^{3/2} \\ &+ 50 \times 5.2^{3/2} + 50 \times 4.4^{3/2} + 50 \times 1.6^{3/2} + 10 \times .2^{3/2} \left. \right] \\ &= 1.45 [14.6 + 185.9 + 385.1 + 592.9 + 771.9 + 945.9 + 2095.2 \\ &+ 966.0 + 809.5 + 592.9 + 461.4 + 101.2 + .9] \\ &= 11489 \approx 11,490 \text{ cfs} \end{aligned}$$

$$Q_{TOT} = Q_c + Q_w = 1280 + 11490 = \underline{\underline{12,770 \text{ cfs}}}$$

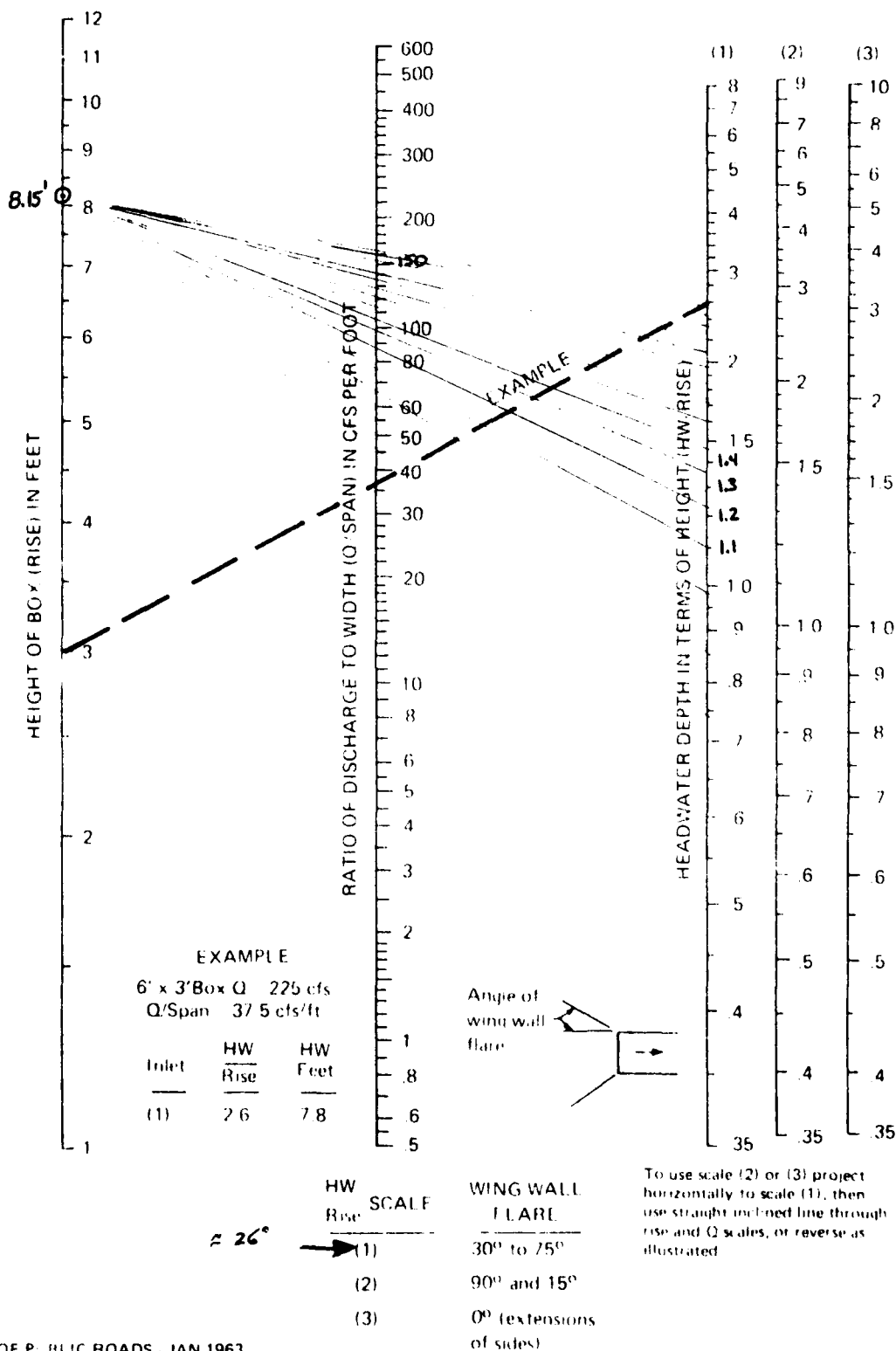
for $h = 21$, elev = 93.6 (overtopping by 8.8')

culvert; for $HW/S_p = 21/8.15 = 2.58$, $Q = 162 \times 8 = 1296 = 1300$ cfs

$$\begin{aligned} \text{weir; } Q_w = \sum CLH^{3/2} &= 1.45 \left[45 \times 1^{3/2} + 50 \times 3.4^{3/2} + 50 \times 4.9^{3/2} + 50 \times 6.2^{3/2} + \right. \\ &50 \times 7.2^{3/2} + 50 \times 8.1^{3/2} + 100 \times 8.6^{3/2} + 50 \times 8.2^{3/2} + 50 \times 7.4^{3/2} + \\ &50 \times 6.2^{3/2} + 50 \times 5.4^{3/2} + 50 \times 2.6^{3/2} + 35 \times .8^{3/2} \left. \right] \\ &= 1.45 [45 + 313.5 + 542.3 + 771.9 + 966.0 + 1152.6 + 2522.0 + \\ &1174.1 + 1006.5 + 771.9 + 627.4 + 209.6 + 25.0] = 14,685 \text{ cfs} \end{aligned}$$

$$Q_{TOT} = Q_c + Q_w = 1300 + 14,680 = 15,980 \text{ cfs}$$

FIGURE 3: Headwater Depth for Concrete Box Culverts With Inlet Control



BUREAU OF PUBLIC ROADS - JAN 1963

ST. JAMES LAKE

2277

STAGE DISCHARGE CALCULATIONS

by AMS

5/4/79

SUMMARY

HEIGHT ABOVE NORMAL POOL (FT)	TOTAL DISCHARGE (CFS)
-------------------------------------	-----------------------------

0	0
1.0	28
2.0	100
3.0	151
4.0	185
5.0	278
6.0	569
7.0	1078
8.0	1820
9.0	2760
10.0	3930
11	5280
12	6830
13	8590
14	10,570
15	12,770

WEIRS SUBMERGED, INLET CONTROL

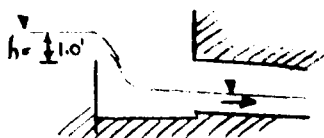
EMBANKMENT OVERTOPPED

NORMAL POOL ELEV = 98.5

MINIMUM EMBANKMENT ELEV = 102.6'

C-11

to late dev. = 99.5 $\therefore h = 1.0'$



assume planking acts as sharp edge weir

for sharp crested weir : Francis weir formula (see Handbook of Applied Hydrology, Davis, 1952)

$$Q = C l [(h + h_v)^{3/2} - (h_v)^{3/2}] \quad \text{where } h_v \approx 0, \quad C = 3.33$$

$$l = l' - 0.1 nh$$

$$\therefore Q = 3.33 l h^{3/2}$$

for $h = 1.0'$ $l = 8.5 - 0.1 \times 2(1.0) = 8.3'$ assume weir control

$$Q = 3.33 (8.3') (1.0')^{3/2} = 27.6 \text{ cfs} \approx 28$$

check inlet control on twin 42" ϕ culverts

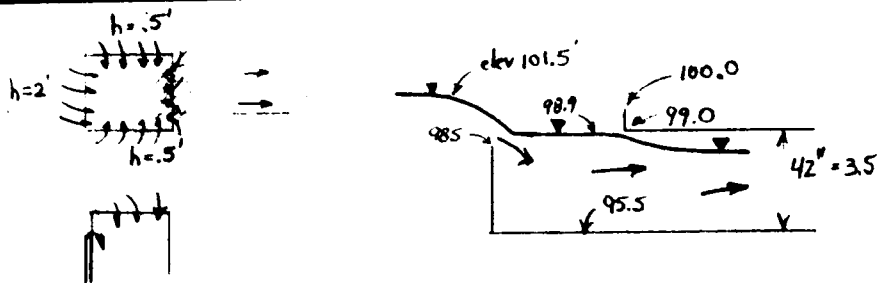
for $Q = 28$ cfs or 14 cfs each with $D = 42"$ see attached fig.

$HW/D \approx \text{small}$, flow controlled by amount over weir

* \therefore for $h = 1.0'$, $Q = 28$ cfs.

(2)

for lake elev = 100.5 ; $h = 2.0'$



assume weir control w/ $h_v = 0$
(Francis submerged weir formula)

Q_T = sharp crested flow + broad crested flow

$$= 3.33 \ell h_1^{3/2} + 2 \times 2.8 \ell h_2^{3/2} = 3.33 A_1 h_1^{3/2} + 5.6 A_2 h_2^{3/2}$$

$$= 3.33 \times 6 \times 1.5^{3/2} + 5.6 (6 \times 1.5) \times 1.5^{3/2} = 76.1 + 24.7 \text{ cfs} = 100.8 \text{ cfs}$$

checking inlet control on twin 42" culverts

for $Q_T = 101 \text{ cfs}$ or $50 \frac{1}{2} \text{ cfs}$ per culvert (42")

then $HW/D = .97$; $HW = 3.4' = \text{elev } 98.9$ one weir partially submerged

correction to Q_T for partially submerged weir

$$Q_T = 3.33 \ell \sqrt{h'} (h + .38 d) + 24.7 \quad \left\{ \begin{array}{l} \text{where } \ell \approx 8.2' \quad h' \approx 1.7 \\ h = 2.0' \quad d \approx .3 \end{array} \right.$$

$$= 3.33 \times 8.2 \times \sqrt{1.7} (2 + .11) + 24.7$$

$$= 75.1 + 24.7 \text{ cfs} = 99.8 \text{ cfs} \approx 100 \text{ cfs or } 50 \text{ cfs each.}$$

checking HW; see fig 9.21 attached, $HW/D = .96 \pm$

$HW = 3.36'$ close enough

* \therefore for $h = 2.0'$, $Q = 100 \text{ cfs}$

3

for lake elev = 101.5', h = 3.0'

assume weirs will be partially submerged

Let $h' = .95 \quad \therefore h_1 = 3.0', d_1 = 2.05'$

$$h_2 = 1.5', \quad d_2 = .55'$$

$$\begin{aligned} Q_T &= 3.33 \ell_1 \sqrt{h'} (h_1 + .381 d_1) + 2 [2.8 \ell_2 \sqrt{h'} (h_2 + .381 d_2)] \\ &= 3.33 (7.7' \pm) \sqrt{95} (3 + .78) + 2 \times 2.8 \times 5.75 \pm \sqrt{95} \times (1.5 + .21) \\ &= 94.4 + 53.7 \text{ cfs} = 148.1 \text{ cfs} \end{aligned}$$

checking flow through culverts

if $h' = .95'$, $HW/D = \frac{6.0 - .95}{3.5} = 1.44$

see fig 9.21 attached; \therefore for $HWP = 1.44$, $Q \approx 77$ cfs each

or $Q_T = 2 \times 77 = 154 \text{ cfs}$

since 148 cfs over weir \approx 154 cfs thru culvert ✓ OK

at this depth, use $Q_T = \text{ave } Q = \frac{154 + 148}{2} = 151 \text{ cfs}$

* for $h = 3.0'$, $Q_T = 151 \text{ cfs}$

for lake elev = 102.5, $h = 4.0'$

assume weirs will be partially submerged

Let $h' = .70'$ \therefore

$$Q_T = 3.33 \ell_1 \sqrt{h''} (h_1 + .38 d_1) + 2 \times 2.8 \ell_2 \sqrt{h''} (h_2 + .38 d_2)$$

$$Q_T = 3.33 \cdot 7.5' \sqrt{7} (4.0 + 1.26) + 2 \times 2.8 \times 5.25' \times \sqrt{7} (2.5 + .68)$$

$$= 109.9 + 78.2 = 188.1 \text{ cfs} \approx 188 \text{ cfs}$$

(cont)

(4)

$$h = 4.0' \text{ (cont.)}$$

checking flow through culverts

if $h' = .7'$; then $HW/D = 7.0 - .7 / 3.5 = 1.8$

see fig 9.21 attached $\therefore Q \approx 91 \text{ cfs}$

or $Q_T = 2 \times 91 = 182 \text{ cfs}$

since 188 cfs over weir $\approx 182 \text{ cfs}$ thru culvert; ✓ ok

assume equilibrium @ $Q = 188 + 182 / 2 = 185 \text{ cfs}$

* for $h = 4.0'$, $Q_T = 185 \text{ cfs}$

for lake elev. = 103.5; $h = 5.0'$

for $h = 5.0'$; embankment overtopped

$$Q_{EM} = \sum C L_i H_i^{3/2} = 1.45 [(7' \times .1^{3/2}) + (30' \times .6^{3/2}) + (30' \times .75^{3/2}) + (30' \times (.5)^{3/2}) + (10' \times .1^{3/2})] = 1.45 [.2 + 13.9 + 19.5 + 10.6 + .3] = 64 \text{ cfs}$$

assume head loss over weirs $\approx .3'$ $\therefore HW/D = 8.0 - .3 / 3.5 = 2.2$

for $HW/D = 2.2$, $Q_{culv} = 2 \times 107 \frac{\text{cfs}}{\text{culv.}} = 214 \text{ cfs}$

$$Q_T = Q_{EM} + Q_{culv.} = 64 + 214 = 278 \text{ cfs}$$

* for $h = 5.0'$, $Q_T = 278 \text{ cfs}$

(5)

for lake elev = 104.5'; $h = 6.0'$

embankment overtopped by 1.9'

$$Q_{EM} = \sum CLH^{3/2} = 1.45 \left[(5 \times .1^{3/2}) + (30 \times .8^{3/2}) + (30 \times 1.6^{3/2}) + (30 \times 1.75^{3/2}) + (30 \times 1.5^{3/2}) + (30 \times .85^{3/2}) + (12 \times .4^{3/2}) \right] =$$

$$= 1.45 [.2 + 21.5 + 60.7 + 69.5 + 55.1 + 23.5 + 3.0] = 339 \text{ cfs}$$

assume head loss over weir $\approx .2'$ $\therefore HW/D = 7.2/3.5 = 2.51$

for $HW/D = 2.51$, $Q = 115 \text{ cfs}$ for 42" ϕ

$$Q_{culv} = 2 \times 115 = 230 \text{ cfs}$$

$$Q_T = Q_{EM} + Q_{culv} = 339 + 230 = 569 \text{ cfs}$$

* for $h = 6.0'$, $Q_T = 569 \text{ cfs}$

for lake elev = 105.5; $h = 7.0'$

embankment overtopped by 2.9'

$$Q_{EM} = \sum CLH^{3/2} = 1.45 \left[30 \times .8^{3/2} + 30 \times 1.8^{3/2} + 30 \times 2.6^{3/2} + 30 \times 2.75^{3/2} + 30 \times 2.5^{3/2} + 30 \times 1.85^{3/2} + 26 \times 1.0^{3/2} \right] = 1.45 [21.5 + 72.4 + 126.8 + 136.8 + 118.6 + 75.5 + 26] = 838 \text{ cfs}$$

assume negligible head loss over weirs $\therefore HW/D = 10/3.5 = 2.86$

for $HW/D = 2.86$, $Q = 120 \text{ cfs}$ for 42" ϕ

$$Q_{culv} = 2 \times 120 = 240 \text{ cfs}$$

$$Q_T = Q_{EM} + Q_{culv} = 838 + 240 = 1078 \text{ cfs}$$

* for $h = 7.0'$, $Q_T = 1078 \text{ cfs}$

(2)

for lake elev = 106.5' ; h = 8.0'

embankment overtopped by 3.9'

$$Q_{EM} = \sum CLH^{\frac{3}{2}} = 1.45 \left[16 \times .5^{\frac{3}{2}} + 30 \times 1.8^{\frac{3}{2}} + 30 \times 2.8^{\frac{3}{2}} + 30 \times 3.6^{\frac{3}{2}} + 30 \times 3.75^{\frac{3}{2}} + 30 \times 3.5^{\frac{3}{2}} + 30 \times 2.85^{\frac{3}{2}} + 30 \times 1.9^{\frac{3}{2}} + 10 \times .4^{\frac{3}{2}} \right]$$

$$= 1.45 [5.6 + 72.4 + 140.6 + 204.9 + 217.9 + 196.4 + 144.3 + 78.6 + 2.5] = 1540 \text{ cfs}$$

for $HW/D = 11/3.5 = 3.14$, $Q = 140$ for 42" ϕ

$$Q_{culv} = 2 \times 140 = 280 \text{ cfs}$$

$$Q = Q_{EM} + Q_{culv} = 1540 + 280 = 1820 \text{ cfs}$$

* for h = 8.0' ; $Q_T = 1820 \text{ cfs}$

for lake elev = 107.5' , h = 9.0'

embankment overtopped by 4.9'

$$Q_{EM} = \sum CLH^{\frac{3}{2}} = 1.45 \left[2' \times \cancel{\phi}^{\circ} + 30 \times 1.3^{\frac{3}{2}} + 30 \times 2.8^{\frac{3}{2}} + 30 \times 3.8^{\frac{3}{2}} + 30 \times 4.6^{\frac{3}{2}} + 30 \times 4.75^{\frac{3}{2}} + 30 \times 4.5^{\frac{3}{2}} + 30 \times 3.85^{\frac{3}{2}} + 30 \times 2.9^{\frac{3}{2}} + 20 \times 1.3^{\frac{3}{2}} \right]$$

$$= 1.45 [44.5 + 140.6 + 222.2 + 296.0 + 310.6 + 286.4 + 226.6 + 148.2 + 29.6] = 2470 \text{ cfs}$$

for $HW/D = 12/3.5 = 3.43$; $Q = 145 \text{ cfs}$

$$Q_{culv} = 2 \times 145 = 290 \text{ cfs}$$

$$Q_T = Q_{EM} + Q_{culv} = 2470 + 290 = 2760 \text{ cfs}$$

* for h = 9.0' , $Q_T = 2760 \text{ cfs}$

(7)

for lake elev = 108.5 ; $h = 10.0$

embankment overtopped by 5.9'

$$Q_{EM} = \sum CLH^{\frac{3}{2}} = 1.45 \left[18 \times 5^{\frac{3}{2}} + 30 \times 2.1^{\frac{3}{2}} + 30 \times 3.8^{\frac{3}{2}} + 30 \times 4.8^{\frac{3}{2}} + 30 \times 5.6^{\frac{3}{2}} + 30 \times 5.5^{\frac{3}{2}} + 30 \times 4.85^{\frac{3}{2}} + 30 \times 3.9^{\frac{3}{2}} + 30 \times 2.5^{\frac{3}{2}} \right]$$

$$= 1.45 [64 + 91.3 + 222.2 + 315.5 + 397.6 + 413.6 + 387.0 + 320.4 + 231.1 + 118.6] = 3630 \text{ cfs}$$

for $HW/D = \frac{13}{35} = 3.71$, $Q = 150 \text{ cfs}$ for 42" ϕ

$$Q_{curv} = 2 \times 150 = 300 \text{ cfs}$$

$$Q_T = Q_{EM} + Q_{curv} = 3630 + 300 = 3930 \text{ cfs}$$

* for $h = 10.0$, $Q_T = 3930 \text{ cfs}$

for lake elev = 109.5 ; $h = 11.0$ — embankment overtopped by 6.9'

$$Q_{EM} = \sum CLH^{\frac{3}{2}} = 1.45 \left[4 \times 1^{\frac{3}{2}} + 30 \times 1.2^{\frac{3}{2}} + 30 \times 3.1^{\frac{3}{2}} + 30 \times 4.8^{\frac{3}{2}} + 30 \times 5.8^{\frac{3}{2}} + 30 \times 6.6^{\frac{3}{2}} + 30 \times 6.75^{\frac{3}{2}} + 30 \times 6.5^{\frac{3}{2}} + 30 \times 5.85^{\frac{3}{2}} + 30 \times 4.9^{\frac{3}{2}} + 30 \times 3.5^{\frac{3}{2}} + 10 \times .5^{\frac{3}{2}} \right]$$

$$= 1.45 [.1 + 39.4 + 163.7 + 315.5 + 419.0 + 508.7 + 526.1 + 497.2 + 424.5 + 325.4 + 196.4 + 3.5] = 4958 \text{ cfs}$$

for $HW/D = \frac{14}{3.5} = 4$ $Q = 160 \times 2 = 320 \text{ cfs}$

$$Q_T = Q_{EM} + Q_{curv} = 4960 + 320 = 5280 \text{ cfs}$$

* for $h = 11.0$, $Q_T = 5280 \text{ cfs}$

(8)

for lake elev 110.5 $h = 12.0$ (embankment overtopped by 7.9')

$$Q_{Em} = \sum CLH^{\frac{3}{2}} = 1.45 \left[20 \times .6^{\frac{3}{2}} + 30 \times 2.2^{\frac{3}{2}} + 30 \times 4.1^{\frac{3}{2}} + 30 \times 5.8^{\frac{3}{2}} + 30 \times 6.8^{\frac{3}{2}} + 30 \times 7.6^{\frac{3}{2}} + 30 \times 7.75^{\frac{3}{2}} + 30 \times 7.5^{\frac{3}{2}} + 30 \times 6.85^{\frac{3}{2}} + 30 \times 5.9^{\frac{3}{2}} + 30 \times 4.5^{\frac{3}{2}} + 20 \times 1^{\frac{3}{2}} \right] = 1.45 [9.3 + 97.9 + 249.1 + 419.0 + 532.0 + 628.6 + 647.3 + 616.2 + 537.8 + 429.9 + 286.4 + 20] = 6487.$$

$$\text{for } HW/D = 15/3.5 = 4.3 \quad Q_c = 170 \times 2 = 340 \text{ cfs}$$

$$Q_T = Q_{Em} + Q_c = 6490 + 340 = 6830 \text{ cfs}$$

for lake elev = 111.5, $h = 13.0$ (embankment overtopped by 8.9')

$$Q_{Em} = \sum CLH^{\frac{3}{2}} = 1.45 \left[4 \times .15^{\frac{3}{2}} + 30 \times 1.3^{\frac{3}{2}} + 30 \times 3.2^{\frac{3}{2}} + 30 \times 5.1^{\frac{3}{2}} + 30 \times 6.8^{\frac{3}{2}} + 30 \times 7.8^{\frac{3}{2}} + 30 \times 8.6^{\frac{3}{2}} + 30 \times 8.75^{\frac{3}{2}} + 30 \times 8.5^{\frac{3}{2}} + 30 \times 7.85^{\frac{3}{2}} + 30 \times 6.9^{\frac{3}{2}} + 30 \times 5.5^{\frac{3}{2}} + 30 \times 1.6^{\frac{3}{2}} \right] = 1.45 [6.2 + 44.5 + 171.7 + 345.5 + 532.0 + 653.5 + 756.6 + 776.5 + 743.4 + 659.8 + 543.7 + 387.0 + 60.7] = 8229 \text{ cfs}$$

$$Q_c \approx 360 \text{ cfs}$$

$$Q_T = Q_{Em} + Q_c = 8230 + 360 = 8590 \text{ cfs}$$

for lake elev = 112.5 $h = 14.0$ (embankment overtopped by 9.9' max.)

$$Q_{Em} = \sum CLH^{\frac{3}{2}} = 1.45 \left[20 \times .6^{\frac{3}{2}} + 30 \times 2.3^{\frac{3}{2}} + 30 \times 4.2^{\frac{3}{2}} + 30 \times 6.1^{\frac{3}{2}} + 30 \times 7.8^{\frac{3}{2}} + 30 \times 8.8^{\frac{3}{2}} + 30 \times 9.6^{\frac{3}{2}} + 30 \times 9.75^{\frac{3}{2}} + 30 \times 9.5^{\frac{3}{2}} + 30 \times 8.85^{\frac{3}{2}} + 30 \times 7.9^{\frac{3}{2}} + 30 \times 6.5^{\frac{3}{2}} + 30 \times 2.6^{\frac{3}{2}} + 10 \times .5^{\frac{3}{2}} \right] = 1.45 [9.3 + 104.6 + 258.2 + 452.0 + 653.5 + 783.2 + 892.3 + 913.3 + 878.4 + 789.8 + 666.1 + 497.2 + 125.8 + 3.5] = 10,190 \text{ cfs}$$

$$Q_c \approx 380 \text{ cfs}$$

$$Q_T = Q_{Em} + Q_c = 10,190 + 380 = 10,570 \text{ cfs}$$

9

for lake elev = 113.5, h = 15.0' (embankment overtopped by 10.9' max)

$$Q_{EM} = \sum CLH^{\frac{3}{2}} = 1.45 \left[5 \times 1^{\frac{3}{2}} + 30 \times 1.3^{\frac{3}{2}} + 30 \times 3.3^{\frac{3}{2}} + 30 \times 5.2^{\frac{3}{2}} + 30 \times 7.1^{\frac{3}{2}} + 30 \times 8.8^{\frac{3}{2}} + 30 \times 9.8^{\frac{3}{2}} + 30 \times 10.6^{\frac{3}{2}} + 30 \times 10.75^{\frac{3}{2}} + 30 \times 10.5^{\frac{3}{2}} + 30 \times 9.85^{\frac{3}{2}} + 30 \times 8.9^{\frac{3}{2}} + 30 \times 7.5^{\frac{3}{2}} + 30 \times 3.6^{\frac{3}{2}} + 20 \times 1 \right] = 1.45 [1.2 + 44.5 + 179.8 + 355.7 + 567.6 + 783.2 + 920.4 + 1035.3 + 1057.4 + 1020.7 + 927.4 + 776.5 + 616.2 + 204.9 + 20] = 12,368 \text{ cfs}$$

$$Q_c \approx 400 \text{ cfs}$$

$$Q_T = Q_{EM} + Q_c = 12,370 + 400 = \underline{\underline{12,770 \text{ cfs}}}$$

up. or
figure

Table 9-1 Discharge Coefficients for Broad Crested Weirs*

Cross section	Upstream head h [m]							
	0.15	0.30	0.45	0.60	0.75	0.90	1.20	1.50
1	1.61	1.86	1.98					
2	1.60	1.80	1.90					
3	1.58	1.75	1.79					
4	1.53	1.64	1.77					
5	1.54	1.62	1.69					
6	1.72	1.88	1.98					
7	1.65	1.88	2.00					
8	1.53	1.80	1.93					
9				1.96	1.96	1.97	1.99	2.02
10				1.94	1.92	1.89	1.92	1.97
11		2.12	2.10	2.08	2.08	2.06	2.04	2.00
12		1.88	1.96	2.01	2.04	2.05	2.05	2.05
13				1.96	1.96	1.96	1.96	1.96
14				1.86	1.86	1.86	1.86	1.86
15	1.81	2.00						
16	2.10	2.35						
17	1.57	1.73	1.80	1.82	1.83	1.83		
18	1.44	1.46	1.55	1.56	1.69	1.76	1.84	
19	1.43	1.47	1.45	1.46	1.47	1.46	1.48	1.59
20	1.48	1.45	1.44	1.44				
21		1.56	1.60	1.65	1.70	1.74	1.84	1.92
22		1.56	1.56	1.55	1.55	1.55	1.55	1.54
23	2.13	2.13	2.13					
24	1.93	1.94	1.94					
25	1.94	1.98	1.97					

*All dimensions are in meters. Tabulated values represent metric weir coefficients.

uation

207

from Practical Hydraulics by
Arthur L. Simon,
1976 by Wiley & Sons

C-21

224 Flow through Hydraulic Structures

allowable headwater elevation. The major components of a culvert are its inlet, the culvert pipe barrel itself, and its outlet with the exit energy dissipator, if any. Each of these components have a definite discharge delivery capacity. The component having the least discharge delivery capacity will control the hydraulic performance of the whole structure.

One speaks of inlet control if, under given circumstances, the discharge of a culvert is dependent only on the headwater above the invert at the entrance, the size of the pipe, and the geometry of the entrance. With the inlet controlling the flow, the slope, length, and roughness of the culvert pipe does not influence the

discharge. In this case, the pipe is always only partly full although the headwater may exceed the top of the pipe entrance and hence the flow enters the pipe under pressure. Figure 9.21 shows a typical nomograph by which the discharge Q could be determined for a culvert of D diameter under a headwater depth HW . The nomograph is for a square-edged entrance in a headwall. Similar nomographs are found in governmental and trade literature for many other entrance conditions. Short culverts with relatively negligible tailwater elevations almost always operate under inlet control. Outlet control occurs when the discharge is dependent on all hydraulic variables of the structure.

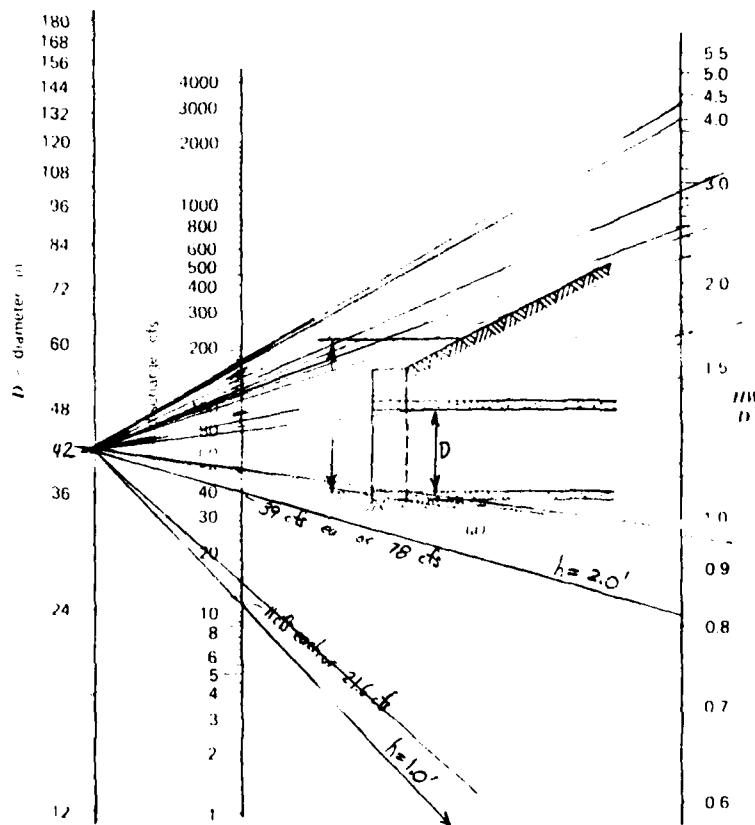


FIGURE 9.21 Typical nomograph for inlet controlled culvert design. (a) Square-edged entrance. (From *Handbook of Concrete Culvert Pipe Hydraulics*, Portland Cement Association, 1964.)

from *Practical Hydraulics*
by Andrew L. Simon
1976, Wiley & Sons C-22

1A1 ST JAMES LAKE DAM

A2 HEC-1DB

A3 PMF-DAM OVERTOPPING ANALYSIS

B	90	1	0	0	0	0	0	0	4
B1	5								
J	1	6	1						
J1	.2	.4	.5	.6	.8	1.0			
K	0	1	0	0	0	0	1		
K1 SUB AREA 1 RUNOFF - CLARK METHOD									
M	1	0	.778	0	5.14	0	0	0	1
P	0	18.5	111	123	133	142			
T	0	0	0	0	0	0	1	0.1	
V	1	1							
X	2	2	1						
K	1	2	0	0	0	0	1		
K1 CHANNEL ROUTE THRU AREA 2									
Y	0	0	0	1	1				
Y1	1	0	0	0	0	0	-1		
Y6	.08	.04	.08	525	550	2400	.004		
Y7	100	550	150	540	180	540	200	525	220
Y7	240	540	500	545	600	550			525
K	0	2	0	0	0	0	1		
K1 SUB AREA 2 RUNOFF									
M	1	0	.865	0	5.14	0	0	0	1
P	0	18.5	111	123	133	142			
T	0	0	0	0	0	0	1	0.1	
V	0.66	0.66							
X	1.3	1.3	1						
K	2	2							
K	1	4	0	0	0	0	1		
K1 CHANNEL ROUTE THRU AREA 3									
Y	0	0	0	1	1				
Y1	1	0	0	0	0	0	-1		
Y6	.08	.04	.08	510	540	4200	.006		
Y7	100	540	250	530	350	520	400	510	420
Y7	600	520	750	530	1050	540			510
K	0	3	0	0	0	0	1		
K1 SUB AREA 3 RUNOFF									
M	1	0	1.618	0	5.14	0	0	0	1
P	0	18.5	111	123	133	142			
T	0	0	0	0	0	0	1	0.1	
V	.82	.82							
X	3.2	3.2	1						
K	0	5	0	0	0	0	1		
K1 SUB AREA 5 RUNOFF									
M	1	0	.732	0	5.14	0	0	0	1
P	0	18.5	111	123	133	142			
T	0	0	0	0	0	0	1	0.1	
V	.94	.94							
X	1.5	1.5	1						
K	1	4	0	0	0	0	1		
K1 CHANNEL ROUTE THRU AREA 4									
Y	0	0	0	1	1				
Y1	1	0	0	0	0	0	-1		
Y6	.08	.04	.08	507	530	4500	.026		
Y7	100	530	200	520	260	515	300	507	320
Y7	360	515	400	520	500	530			507
K	0	4	0	0	0	0	1		
K1 SUB AREA 4 RUNOFF									
M	1	0	1.144	0	5.14	0	0	0	1
P	0	18.5	111	123	133	142			
T	0	0	0	0	0	0	1	0.1	

V	.94	.94								
X	2	2	1							
K	4	4								
K	1	4	0	0	0	0	1			
K1 ROUTE THRU ST JAMES LAKE DAM										
Y	0	0	0	1	1					
Y1	1	0	0	0	0	0	-1			
Y4	511	512	513	514	515	516	517	518	519	520
Y4	521	522	523	524	525	526				
Y5	0	28	100	151	185		569	1078	1820	2760
Y5	3930	5280	6830	8590	10570	12770				
\$S	0	32.2	50.5	233.5	416.5	599.5				
\$E	500	503	504	514	524	534				
\$8	511	8.5	3.2	1.5						
\$D	517	2.64	1.5	200						
K	1	5	0	0	0	0	1			
K1 CHANNEL ROUTE THRU AREA 6										
Y	0	0	0	1	1					
Y1	1	0	0	0	0	0	-1			
Y6	.08	.04	.08	493	520	1300	.011			
Y7	100	520	200	510	250	500	350	493	370	500
Y7	500	500	550	510	650	520				
K	0	6	0	0	0	0	1			
K1 SUB AREA 6 RUNOFF										
M	1	0	0.344	0	5.14	0	0	0	1	
P	0	18.5	111	122	133	142				
T	0	0	0	0	0	0	1	0.1		
V	.38	.38								
X	1	1	1							
K	2	5								
K	1	6	0	0	0	0	1			
K1 ROUTE THRU CULVERT BELOW DAM										
Y	0	0	0	1	1					
Y1	1	0	0	0	0	0	-1			
Y4	499	500	501	502	503	504	505	506	507	508
Y4	509	510	511	512	513	514	515	516	517	518
Y5	25	70	100	185	250	360	440	500	600	700
Y5	800	850	980	1470	2345	3680	5260	7410	9900	12770
K	99									

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

1 PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
RUNOFF HYDROGRAPH AT	2
COMBINE 2 HYDROGRAPHS AT	2
ROUTE HYDROGRAPH TO	4
RUNOFF HYDROGRAPH AT	3
RUNOFF HYDROGRAPH AT	5
ROUTE HYDROGRAPH TO	4
RUNOFF HYDROGRAPH AT	4
COMBINE 4 HYDROGRAPHS AT	4
ROUTE HYDROGRAPH TO	4
ROUTE HYDROGRAPH TO	5
RUNOFF HYDROGRAPH AT	6
COMBINE 2 HYDROGRAPHS AT	5
ROUTE HYDROGRAPH TO	6
END OF NETWORK	

FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE# 79/05/23.
 TIME# 09.35.59.

ST JAMES LAKE DAM
 HEC-1DB
 PMF-DAM OVERTOPPING ANALYSIS

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	ININ	METRC	IPLT	IPRT	NSTAN
90	1	0	0	0	0	0	0	4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIO= 6 LRTIO= 1
 RTIOS= .20 .40 .50 .60 .80 1.00

SUB-AREA RUNOFF COMPUTATION

SUB AREA 1 RUNOFF - CLARK METHOD

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDC	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	.78	0.00	5.14	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA
 TC= 1.00 R= 1.00 NTA= 0

RECESSION DATA
 STRTQ= 2.00 QRCSN= 2.00 RTIOR= 1.00

UNIT HYDROGRAPH 6 END-OF-PERIOD ORDINATES, LAG= .98 HOURS, CP= .53 VOL= 1.00
 167. 223. 74. 25. 8. 3.

END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
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SUM 21.02 17.37 3.65 8872.
 (534.)(441.)(93.)(251.23)

HYDROGRAPH ROUTING

CHANNEL ROUTE THRU AREA 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA							
QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTD	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0800	.0400	.0800	525.0	550.0	2400.	.00400

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

100.00	550.00	150.00	540.00	180.00	540.00	200.00	525.00	220.00	525.00
240.00	540.00	500.00	545.00	600.00	550.00				

STORAGE	0.00	1.58	3.41	5.49	7.83	10.43	13.28	16.38	19.74	23.35
	27.22	31.34	37.95	50.46	68.40	91.78	119.62	149.90	182.58	217.63
OUTFLOW	0.00	75.04	242.80	489.51	813.99	1218.10	1704.87	2277.82	2940.75	3697.54
	4552.12	5508.42	6754.24	8411.09	10487.41	13073.73	16357.78	20248.74	24718.88	29778.51
STAGE	525.00	526.32	527.63	528.95	530.26	531.58	532.89	534.21	535.53	536.84
	538.16	539.47	540.79	542.11	543.42	544.74	546.05	547.37	548.68	550.00
FLOW	0.00	75.04	242.80	489.51	813.99	1218.10	1704.87	2277.82	2940.75	3697.54
	4552.12	5508.42	6754.24	8411.09	10487.41	13073.73	16357.78	20248.74	24718.88	29778.51

MAXIMUM STAGE IS 528.5

MAXIMUM STAGE IS 530.2

MAXIMUM STAGE IS 530.9

MAXIMUM STAGE IS 531.6

MAXIMUM STAGE IS 532.6

MAXIMUM STAGE IS 533.6

SUB-AREA RUNOFF COMPUTATION

SUB AREA 2 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	.87	0.00	5.14	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

TC= .66 R= .66 NTA= 0

RECESSION DATA

STRTQ= 1.30 QRCSN= 1.30 RTIOR= 1.00

UNIT HYDROGRAPH 4 END-OF-PERIOD ORDINATES, LAG= .86 HOURS, CP= .52 VOL= 1.00
240. 274. 38. 5.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
-------	-------	--------	------	------	------	--------	-------	-------	--------	------	------	------	--------

SUM 21.02 17.37 3.65 9768.
(534.)(441.)(93.)(276.60)

COMBINE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	2	0	0	0	0	0	0	0

AD-A086 225

NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. ST. JAMES LAKE DAM (INVENTORY NUMB--ETC(U)
FEB 80 J B STETSON DACW51-79-C-0001

UNCLASSIFIED

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HYDROGRAPH ROUTING

CHANNEL ROUTE THRU AREA 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0
ROUTING DATA								
GLOSS	CLOSS	AVC	IRES	ISAME	IOPT	IPMP	LSTR	
0.0	0.000	0.00	1	1	0	0	0	
NSTPS	NSTD	LAG	AMSK	X	TSK	STORA	ISPRAT	
1	0	0	0.000	0.000	0.000	-1.	0	

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0800	.0400	.0800	510.0	540.0	4200.	.00600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

100.00	540.00	250.00	530.00	350.00	520.00	400.00	510.00	420.00	510.00
600.00	520.00	750.00	530.00	1050.00	540.00				

STORAGE	0.00	5.81	17.15	34.01	56.41	84.33	117.79	156.87	201.95	253.03
	310.12	373.22	442.32	517.71	602.84	698.80	805.56	923.15	1051.55	1190.77
OUTFLOW	0.00	181.42	790.36	1984.88	3908.38	6691.62	10456.18	16091.25	23306.45	31755.25
	41468.30	52476.77	64812.95	78375.03	93207.27	109708.25	127955.86	148034.05	170027.56	194020.07
STAGE	510.00	511.58	513.16	514.74	516.32	517.89	519.47	521.05	522.63	524.21
	525.79	527.37	528.95	530.53	532.11	533.68	535.26	536.84	538.42	540.00
FLOW	0.00	181.42	790.36	1984.88	3908.38	6691.62	10456.18	16091.25	23306.45	31755.25
	41468.30	52476.77	64812.95	78375.03	93207.27	109708.25	127955.86	148034.05	170027.56	194020.07

MAXIMUM STAGE IS 513.3

MAXIMUM STAGE IS 514.4

MAXIMUM STAGE IS 514.9

MAXIMUM STAGE IS 515.3

MAXIMUM STAGE IS 516.0

MAXIMUM STAGE IS P 516.6

SUB-AREA RUNOFF COMPUTATION

SUB AREA 3 RUNOFF

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDC	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	1.62	0.00	5.14	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

TC= .82 R= .82 NTA= 0

RECESSION DATA

STRTQ= 3.20 QRCSN= 3.20 RTIOR= 1.00

UNIT HYDROGRAPH 5 END-OF-PERIOD ORDINATES, LAG= .92 HOURS, CP= .53 VOL= 1.00

395.	491.	119.	29.	7.
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END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
-------	-------	--------	------	------	------	--------	-------	-------	--------	------	------	------	--------

SUM	21.02	17.37	3.65	18360.
	(534.)	(441.)	(93.)	(519.90)

SUB-AREA RUNOFF COMPUTATION

SUB AREA 5 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INHYD	IUMG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	.73	0.00	5.14	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

TC= .94 R= .94 NTA= 0

RECESSION DATA

STRTQ= 1.50 QRCSN= 1.50 RTIOR= 1.00

UNIT HYDROGRAPH 6 END-OF-PERIOD ORDINATES, LAG= .96 HOURS, CP= .53 VOL= 1.00
 164. 214. 65. 20. 6. 2.

END-OF-PERIOD FLOW

NO.DA	HR.MM	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MM	PERIOD	RAIN	EXCS	LOSS	COMP Q
-------	-------	--------	------	------	------	--------	-------	-------	--------	------	------	------	--------

SUM 21.02 17.37 3.65 8352.
 (534.)(441.)(93.)(236.50)

HYDROGRAPH ROUTING

CHANNEL ROUTE THRU AREA 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA							
QLOSS	CLOSS	AVC	IRES	ISAME	IOPT	IPWP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTD	LAG	AMSK	X	TSK	STOR	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0000	.0400	.0800	507.0	530.0	4500.	.02600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

100.00	530.00	200.00	520.00	260.00	515.00	300.00	507.00	320.00	507.00
360.00	515.00	400.00	520.00	500.00	530.00				

STORAGE	0.00	3.26	8.03	14.32	22.11	31.43	42.26	54.71	69.92	88.15
	109.41	133.69	161.01	191.35	224.72	261.12	300.54	343.00	388.48	436.98
OUTFLOW	0.00	186.26	675.21	1504.24	2725.15	4389.01	6544.93	9499.55	13477.32	18146.79
	23555.49	29745.89	36759.61	44634.26	53406.31	63111.75	73785.95	85463.70	98179.19	111966.07
STAGE	507.00	508.21	509.42	510.63	511.84	513.05	514.26	515.47	516.68	517.89
	519.11	520.32	521.53	522.74	523.95	525.16	526.37	527.58	528.79	530.00
FLOW	0.00	186.26	675.21	1504.24	2725.15	4389.01	6544.93	9499.55	13477.32	18146.79
	23555.49	29745.89	36759.61	44634.26	53406.31	63111.75	73785.95	85463.70	98179.19	111966.07

MAXIMUM STAGE IS 508.7

MAXIMUM STAGE IS 509.6

MAXIMUM STAGE IS 509.8

MAXIMUM STAGE IS 510.1

MAXIMUM STAGE IS 510.7

MAXIMUM STAGE IS 511.1

SUB-AREA RUNOFF COMPUTATION

SUB AREA 4 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDC	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	1.14	0.00	5.14	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

TC= .94 R= .94 NTA= 0

RECESSION DATA

STRTQ= 2.00 QRCSN= 2.00 RTIOR= 1.00

UNIT HYDROGRAPH 6 END-OF-PERIOD ORDINATES, LAG= .96 HOURS, CP= .53 VOL= 1.00

256. 334. 102. 31. 10. 3.

END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
-------	-------	--------	------	------	------	--------	-------	-------	--------	------	------	------	--------

SUM	21.02	17.37	3.65	12971.
	(534.)	(441.)	(93.)	(367.30)

COMBINE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	4	0	0	0	0	0	0	0

HYDROGRAPH ROUTING

ROUTE THRU ST JAMES LAKE DAM

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO	
	4	1	0	0	0	0	1	0	0	
ROUTING DATA										
	CLOSS	CLOSS	AVG	IRES	ISANE	IOPT	IPMP	LSTR		
	0.0	0.000	0.00	1	1	0	0	0		
	NSTPS	NSTD	LAG	ANSKK	X	TSK	STORA	ISPRAT		
	1	0	0	0.000	0.000	0.000	-1.	0		
STAGE	511.00	512.00	513.00	514.00	515.00	516.00	517.00	518.00	519.00	520.00
	521.00	522.00	523.00	524.00	525.00	526.00				
FLOW	0.00	28.00	100.00	151.00	185.00	278.00	569.00	1078.00	1820.00	2760.00
	3930.00	5280.00	6830.00	8590.00	10570.00	12770.00				
CAPACITY=	0.	32.	51.	234.	417.	600.				
ELEVATION=	500.	503.	504.	514.	524.	534.				
	CREL	SPWID	COQM	EXPW	ELEVL	COQL	CAREA	EXPL		
	511.0	8.5	3.2	1.5	0.0	0.0	0.0	0.0		
DAM DATA										
	TOPEL	COQD	EXPD	DAMWID						
	517.0	2.6	1.5	200.						

PEAK OUTFLOW IS 3081. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 5453. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 7046. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 8383. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 10962. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 13760. AT TIME 41.00 HOURS

HYDROGRAPH ROUTING

CHANNEL ROUTE THRU AREA 6

ISTAQ	ICMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPNP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTD	LAC	AMSK	X	TSK	STOR	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0000	.0400	.0800	493.0	520.0	1300.	.01100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

100.00	520.00	200.00	510.00	250.00	500.00	350.00	493.00	370.00	500.00
500.00	500.00	550.00	510.00	650.00	520.00				

	0.00	.52	2.07	4.65	8.27	13.32	24.27	35.82	47.97	60.73
STORAGE	74.09	88.05	102.62	118.11	134.80	152.70	171.81	192.12	213.64	236.36
OUTFLOW	0.00	53.42	339.20	1000.08	2153.79	2556.30	6802.20	12610.93	19846.02	28427.18
	38302.21	49435.38	61791.99	75180.19	89898.13	105954.09	123365.34	142153.08	162340.48	183951.76
STAGE	493.00	494.42	495.84	497.26	498.68	500.11	501.53	502.95	504.37	505.79
	507.21	508.63	510.05	511.47	512.89	514.32	515.74	517.16	518.58	520.00
FLOW	0.00	53.42	339.20	1000.08	2153.79	2556.30	6802.20	12610.93	19846.02	28427.18
	38302.21	49435.38	61791.99	75180.19	89898.13	105954.09	123365.34	142153.08	162340.48	183951.76

MAXIMUM STAGE IS 500.2

MAXIMUM STAGE IS 501.1

MAXIMUM STAGE IS 501.5

MAXIMUM STAGE IS 501.9

MAXIMUM STAGE IS 502.6

MAXIMUM STAGE IS 503.2

SUB-AREA RUNOFF COMPUTATION

SUB AREA 6 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INYDC	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	.34	0.00	5.14	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	111.00	122.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

TC= .38 R= .38 NTA= 0

RECESSION DATA

STRTO= 1.00 QRCSN= 1.00 RTIOR= 1.00

UNIT HYDROGRAPH 2 END-OF-PERIOD ORDINATES, LAG= .79 HOURS, CP= .50 VOL= 1.00
111. 111.

END-OF-PERIOD FLOW

NO.DA	HR.MM	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MM	PERIOD	RAIN	EXCS	LOSS	COMP Q
-------	-------	--------	------	------	------	--------	-------	-------	--------	------	------	------	--------

SUN	21.02	17.36	3.66	3942.
	(534.)	(441.)	(93.)	(111.63)

COMBINE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	2	0	0	0	0	0	0	0

HYDROGRAPH ROUTING

ROUTE THRU CULVERT BELOW DAM

	ISTAG	ICOMP	IECON	ITAPE	JPLY	JPRT	INAME	ISTAGE	IAUTO	
	6	1	0	0	0	0	1	0	0	
	ROUTING DATA									
	QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPNP	LSTR		
	0.0	0.000	0.00	1	1	0	0	0		
	NSTPS	NSTD	LAG	AMSK	X	TSK	STOR	ISPRAT		
	1	0	0	0.000	0.000	0.000	-1.	0		
STAGE	499.00	500.00	501.00	502.00	503.00	504.00	505.00	506.00	507.00	508.00
	509.00	510.00	511.00	512.00	513.00	514.00	515.00	516.00	517.00	518.00
FLOW	25.00	70.00	100.00	185.00	250.00	360.00	440.00	500.00	600.00	700.00
	800.00	850.00	900.00	1470.00	2345.00	3680.00	5260.00	7410.00	9900.00	12770.00
MAXIMUM STAGE IS	510.0									
MAXIMUM STAGE IS	512.6									
MAXIMUM STAGE IS	513.1									
MAXIMUM STAGE IS	513.6									
MAXIMUM STAGE IS	514.4									
MAXIMUM STAGE IS	515.1									

***** ***** ***** ***** *****

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS					
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
				.20	.40	.50	.60	.80	1.00
HYDROGRAPH AT	1	.78	1	395.	790.	988.	1185.	1580.	1975.
	(	2.02)	(	11.19)	(22.37)	(27.97)	(33.56)	(44.75)	(55.94)
ROUTED TO	2	.78	1	405.	808.	1010.	1210.	1614.	2016.
	(	2.02)	(	11.47)	(22.87)	(28.60)	(34.27)	(45.70)	(57.08)
HYDROGRAPH AT	2	.87	1	462.	924.	1155.	1386.	1848.	2310.
	(	2.24)	(	13.08)	(26.17)	(32.71)	(39.25)	(52.34)	(65.42)
2 COMBINED	2	1.64	1	867.	1732.	2165.	2596.	3462.	4326.
	(	4.26)	(	24.55)	(49.04)	(61.31)	(73.52)	(98.03)	(122.50)
ROUTED TO	4	1.64	1	880.	1760.	2216.	2676.	3550.	4440.
	(	4.26)	(	24.92)	(49.84)	(62.75)	(75.77)	(100.52)	(125.73)
HYDROGRAPH AT	3	1.62	1	847.	1694.	2118.	2542.	3389.	4236.
	(	4.19)	(	23.99)	(47.98)	(59.98)	(71.97)	(95.96)	(119.95)
HYDROGRAPH AT	5	.73	1	376.	751.	939.	1127.	1503.	1879.
	(	1.90)	(	10.64)	(21.28)	(26.60)	(31.92)	(42.56)	(53.20)
ROUTED TO	4	.73	1	384.	775.	967.	1155.	1533.	1928.
	(	1.90)	(	10.88)	(21.94)	(27.39)	(32.71)	(43.41)	(54.60)
HYDROGRAPH AT	4	1.14	1	587.	1174.	1468.	1761.	2349.	2936.
	(	2.96)	(	16.63)	(33.25)	(41.56)	(49.88)	(66.50)	(83.13)
4 COMBINED	4	5.14	1	2699.	5403.	6769.	8134.	10820.	13540.
	(	13.30)	(	76.42)	(153.01)	(191.68)	(230.33)	(306.39)	(383.41)
ROUTED TO	4	5.14	1	3081.	5453.	7046.	8383.	10962.	13760.
	(	13.30)	(	87.24)	(154.41)	(199.53)	(237.38)	(310.40)	(389.63)
ROUTED TO	5	5.14	1	2945.	5433.	6818.	8270.	11175.	13890.
	(	13.30)	(	83.38)	(153.86)	(193.05)	(234.18)	(316.45)	(393.31)
HYDROGRAPH AT	6	.34	1	189.	378.	472.	567.	756.	945.
	(	.89)	(	5.35)	(10.70)	(13.38)	(16.05)	(21.40)	(26.75)
2 COMBINED	5	5.48	1	3130.	5804.	7281.	8826.	11917.	14816.
	(	14.20)	(	88.63)	(164.35)	(206.17)	(249.92)	(337.44)	(419.54)
ROUTED TO	6	5.48	1	840.	2024.	2528.	3106.	4272.	5421.
	(	14.20)	(	24.02)	(57.30)	(71.59)	(87.96)	(120.96)	(153.52)

PLAN 1		STATION 2	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	405.	528.5	41.00
.40	808.	530.2	41.00
.50	1010.	530.9	41.00
.60	1210.	531.6	41.00
.80	1614.	532.6	41.00
1.00	2016.	533.6	41.00

PLAN 1		STATION 4	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	880.	513.3	41.00
.40	1760.	514.4	41.00
.50	2216.	514.9	41.00
.60	2676.	515.3	41.00
.80	3550.	516.0	41.00
1.00	4440.	516.6	41.00

PLAN 1		STATION 4	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	384.	508.7	41.00
.40	775.	509.6	41.00
.50	967.	509.8	41.00
.60	1155.	510.1	41.00
.80	1533.	510.7	41.00
1.00	1928.	511.1	41.00

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
		500.00	511.00	517.00
	STORAGE	0.	179.	288.
	OUTFLOW	0.	0.	400.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	519.73	2.73	338.	3081.	5.00	41.00	0.00
.40	521.21	4.21	365.	5453.	6.00	41.00	0.00
.50	522.08	5.08	381.	7046.	8.00	41.00	0.00
.60	522.75	5.75	394.	8383.	8.00	41.00	0.00
.80	523.96	6.96	416.	10962.	9.00	41.00	0.00
1.00	525.16	8.16	438.	13760.	9.00	41.00	0.00

PLAN 1		STATION 5	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS

APPENDIX D

REFERENCES

APPENDIX

REFERENCES

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